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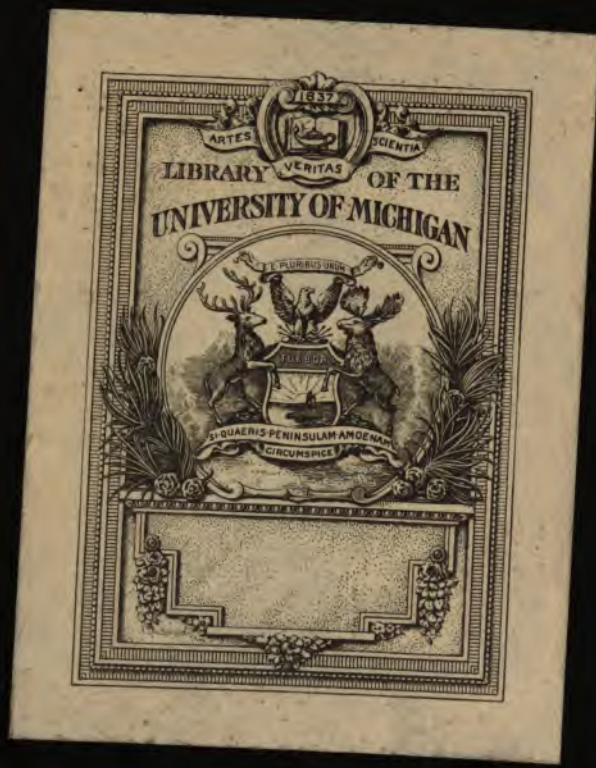
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TRANSACTIONS

OF

The Epidemiological Society of London.

CONSIDERATIONS IN RESPECT TO "RETURN" CASES OF SCARLATINA.

By T. W. THOMPSON, L.R.C.P. Edin., M.R.C.S. Eng.

(*Read: November* 15*th*, 1895.)

Mr. President and Gentlemen,—I propose to ask your attention this evening to the subject of so-called "return" cases of scarlatina, by which I understand fresh cases of scarlatina occurring in previously invaded households under circumstances which lead to their being attributed to the return thither of recently discharged patients from Isolation Hospitals.

The circumstances attending the so-called "return case" appear to be somewhat as follows:—

A household becomes newly invaded by scarlatina, and the person first attacked is removed to hospital. During the eight or so weeks of his detention there, the household frequently, though not invariably, remains free from further invasion by scarlatina. A few days after his return home, however, a fresh case, the so-called "return" case, occurs, and is regarded as being due to the arrival in the dwelling of this patient from hospital. In a certain proportion of instances—though by no means in all—the recently returned hospital patient is now found, upon examination, to exhibit some evidence of desquamation, or to be suffering from discharge from the nose or ears; a discovery which is naturally held to strengthen the belief in his having reintroduced infection into the household. Such, then, is a brief outline of the history of the ordinary "return" case.

Theoretically, no doubt, the subject should be dealt with upon a wider basis, since it constitutes a branch of the more general subject of the dissemination of infectious

diseases by discharged hospital patients. For not only do "return" cases probably occur in connection with other diseases, at all events, it would seem, in connection with diphtheria, but it sometimes doubtless happens that discharged hospital patients initiate disease in households other than their own, and that they are also the means, perhaps, of introducing disease into schools and kindred institutions. Practically, however, there will, I think, be advantage in confining our attention this evening to "return" cases of scarlatina; for while on the one hand it is in connection with this disease that we have most experience in regard to cases of the sort in question, on the other hand the subject, even as thus limited, will, I think, afford us as many etiological problems as we shall be able to consider profitably in the time at our disposal.

In regard to the subject I have selected—a subject which appears to be daily attracting increased attention, both among those engaged in public health administration and also among those responsible for the administration of Isolation Hospitals—I venture to hope that I need offer no apology. That it is one of some importance will, I anticipate, begenerally conceded; for if it is true that the return home of patients from Isolation Hospitals results, in any appreciable number of instances, in the re-introduction of scarlatina to their households, to that extent it would seem are we at present failing to obtain what, on theoretical grounds at all events, is to be regarded as the full benefit of our isolation procedures. It is clearly of importance, then, that we should endeavour to ascertain the extent of our failure in this respect, and, if possible, the means by which it may be remedied.

In regard to my treatment of the subject, however, I feel that some apology is called for, since I must at once confess that I am not prepared to put before you the results of anything approaching to an exhaustive statistical or other study of the matter. My purpose, indeed, is rather to seek information than to give it. Having upon one or two occasions been brought into official relations with the subject, I have become impressed with the need for its more systematic study, and it seemed to me that the mutual deliberations of those interested in the matter would form a valuable preliminary to such study in the sense at least of tending to clear the ground, and of thus leading, perhaps, to some approach to agreement as to the general aspect from which so-called "return" cases should for the most part be regarded. And this appeared to me

the more desirable in view of diverse mental attitudes from which the subject has hitherto often been approached.

Lastly, it seemed to me that, of all societies, the Epidemiological Society should be especially fitted to throw light upon the matter, comprising as it does among its members not only many Medical Officers of Health, some of whom must have been brought into contact with "return" cases of scarlatina in their public health aspect, but also not a few Medical Superintendents of Isolation Hospitals, who have had experience—and doubtless anxious experience—of such cases from the hospital standpoint; while the Society also, of course, numbers many members who, having paid special attention to general etiological questions, might be expected to throw light upon some of the more obscure problems which, as I venture to think, are not improbably involved in the subject under consideration.

So far as I am concerned, therefore, my main purpose is to endeavour to set out, as a basis for discussion, the several considerations which have occurred to me as being probably bound up with this matter, and to indicate, by the way, the particular points which have appeared to me as being specially deserving of attention.

I have spoken of the subject of "return" cases of scarlatina as daily attracting increased attention, and that such is the fact is, I think, sufficiently evident from the comparative frequency with which communications respecting it have recently appeared in the medical journals, and in the Annual Reports of Medical Officers of Health. I do not infer from this fact that the hospital isolation of cases of scarlatina was in earlier years unattended by mishaps of the kind; and, indeed, it appears certain, from such inquiries as I have been able to make, that such was not the case. Nor does it seem likely that any general increase has of late years occurred in the proportion of cases of a kind that might be regarded as "return" cases, to the number of patients isolated. It may, I think, therefore be surmised that the increased attention which the matter is now attracting is due partly to the absolute increase in the number of such cases consequent upon the general growth of isolation procedures, and partly to the closer scrutiny into the origin of new cases of scarlatina which has resulted from more complete sanitary organisation, and which has been especially facilitated by the compulsory notification of infectious diseases —the result being that not only are "return" cases now

absolutely more numerous, but such as do occur are more likely to be brought to light.

With respect to the growth of hospital isolation as a method of dealing with scarlatina, it appears from a return made to the Local Government Board, in the year 1879, that only some 18 per cent. of the sanitary authorities in England and Wales had at that time made isolation provision of any sort; and I learn from Dr. Thorne Thorne's Report upon the "Use and Influence of Hospitals for Infectious Diseases", that the provision made, even by such authorities, amounted in many instances to provision only in name. According to a further Return made to the Board in 1893, it appears, however, that the proportion of the total sanitary authorities then in possession of isolation accommodation of one or another kind was practically double that of 1879. During recent years, moreover, considerable improvement has taken place in the character as well as in the amount of isolation accommodation available, and it is certain that this has largely contributed to the more general use of Isolation Hospitals by the public.

As a general result, then, of the increase in the number of Isolation Hospitals, and the improvement in their character, a considerably larger proportion of the total cases of infectious disease occurring in the country are now removed to hospital than was formerly the case. And that this is especially true in regard to scarlatina is, I think, evident from the fact that, whereas the earlier hospitals mostly owed their origin to the occurrence of, or to the fear of, epidemics of small-pox, typhus, or cholera, the isolation of scarlatina has, it appears to me, most frequently afforded the primary object of the more recently erected permanent hospitals. As regards London, which is, of course, of especial importance for our present purpose, it was not until recent years that any systematic provision was made out of the public funds for the isolation of non-pauper cases of infectious illness, though it is true that, owing to one or another cause, a progressive increase from year to year had, prior to this, occurred in the proportion of the cases of London scarlatina which had been removed to the hospitals of the Metropolitan Asylums Board.

With respect to the increased resort by the London public to Isolation Hospitals, the Registrar-General, in his Annual Report for the year 1891, points out that whereas, during that year, 62 per cent. of the total deaths from scarlatina occurred in the Metropolitan Asylum and London

Fever Hospitals, during the year 1878 the proportion was not more than 7 per cent. And according to the Annual Report for 1894 of the Statistical Committee of the Metropolitan Asylums Board, it appears that the proportion of the total notified cases of scarlatina admitted to the hospitals of that Board increased from 42.6 in 1890, to 62.9 per cent. in 1894. And the Committee further estimate that a few years previously the proportion of persons suffering from "fevers and diphtheria" admitted to their hospitals was not more than 11 per cent.

From what has been said, then, it appears to me that the greater use now made of Isolation Hospitals, coupled with the greater facilities for the detection of apparent "return" cases when they occur, afford an adequate explanation of the growing attention which the subject is attracting.

The real importance of the matter for us, however, must, of course, depend upon the frequency with which these so-called "return" cases occur relatively to the number of patients isolated. In the 1894 Report of the Statistical Committee of the Metropolitan Asylums Board, to which reference has already been made, it is pointed out that such cases "are not insignificant in number"; and attention is called to the statement of Dr. Birdwood, the Medical Superintendent of the North-Eastern Hospital, to the effect that at that hospital alone it was reported on sixty-one occasions, presumably during the year in question, "that a recovered patient had returned home from one of the Board's hospitals before the outbreak of illness amongst the other members of the family or household". If it could be assumed that the proportion of such cases heard of at the North-Eastern Hospital to the number of patients discharged therefrom represented approximately the proportion heard of to the patients discharged at the other hospitals of the Metropolitan Asylums Board, it would appear that, during the year in question, some 3½ per cent. of the dismissals from those hospitals were followed by—though, as Dr. Birdwood clearly shows, by no means necessarily the cause of—fresh cases in the households to which they returned.

According, however, to a notice in one of the medical journals, which I have only this afternoon seen, of a Report which has been presented to the Metropolitan Asylums Board by a sub-committee appointed to inquire into cases of illness alleged to have been caused by the premature discharge of patients from that Board's hospitals, it would appear

that the assumption to which I have referred is not borne out by facts, since it is stated in this notice that cases of the kind occurred only in the proportion of one to every 285 discharges. Unfortunately, I am unable to gather from this short account whether the percentage is calculated only upon cases heard of in the sense of complaint, or upon all secondary cases occurring in households shortly after the return of patients from hospital, as ascertained from notification returns. In any case it would seem that the rate was a low one, for in a paper on "'Return' Cases of Scarlet Fever", published in the *Lancet* of June 22nd, 1895, by Dr. Chalmers, Medical Officer of Health to the City of Glasgow, it will be seen that scarlatina reappeared in 2.6 per cent. of the households to which, during the year 1894, the 2,953 scarlatina patients who were discharged from the three Glasgow Fever Hospitals returned. There appear to me, moreover, reasons for thinking that this Glasgow experience compares favourably with that of some other well-appointed and apparently well administered hospitals. There can thus be little doubt that the rate will be found to vary in different times and places, and that where the figures are small the variations will be considerable.

And now, what is the meaning of these so-called "return" cases of scarlatina? How are they to be explained?

Among the members of the reinvaded families, the explanations which perhaps not unnaturally seem to find most favour are based upon an assumed negligence on the part of the hospital authorities; either, and perhaps most commonly, it is concluded that the recently returned patient from the hospital was, owing to want of care on the part of the hospital officials, allowed to leave that institution while still exhibiting indications of infectiveness, which might have been, and ought to have been, detected; or it is taken for granted that, owing to defective arrangements at the hospital for disinfection, or to some other form of defective administration, infection was allowed to be carried from the hospital to the dwelling by the clothing or the hair of the patient, or in some other mechanical fashion.

On the other hand, among those who regard the matter more especially from the hospital standpoint, the tendency seems perhaps rather to rely for explanation of "return" cases upon circumstances other than the direct infectiveness of the recently discharged patients themselves, and independent also of the conveyance by such patients of

infection from the hospital, in any preventable ways. Thus stress may be laid upon the possibility of the fresh case having resulted from some independent source of infection; its time relation to the return of the patient from hospital being regarded as probably a mere coincidence. Or the fresh case may be attributed to defective disinfection of the dwelling and its contents by the sanitary authority, after the removal of the primary case to hospital. And the likelihood of this last cause accounting for a proportion at least of the so-called "return" cases, is often emphasised by reference to the fact that a fresh case of scarlatina not very infrequently occurs in a household, on or about the date upon which it had been arranged that the primary case should return home from the hospital, notwithstanding that, owing to one or other cause, that patient's return was unexpectedly postponed until after the occurrence of the fresh case in the dwelling. Such experiences, it is contended, and apparently not without reason, suggest that the fresh case in the dwelling probably owed its origin to the unpacking, in preparation for the home-coming of the hospital patient, of some garment which had been worn by that patient prior to his removal to hospital, and which had, upon his departure from home, been packed away in a drawer or box out of reach of any aerial disinfectant which might have been subsequently employed.

Another explanation often given attributes a not insignificant proportion of "return" cases to the alleged infectivity, for a certain period, of the breath of recently discharged patients from fever hospitals; the lungs being regarded as mechanical carriers of the infective material with which they have become charged during the prolonged residence of the patients in an infected atmosphere.

That each of the explanations to which I have referred may, and probably does, correctly account for some uncertain number of so-called "return" cases is likely enough, but that they either severally or collectively account for them all appears to me open to considerable doubt.

In regard to the explanations of the first class, it is evident, of course, that any carelessness on the part of the medical superintendents of hospitals, in respect of the discharge of patients, would obviously be not unlikely to contribute to the occurrence of genuine "return" cases. The whole principle of isolation implies the need for the detention of patients in hospital so long as they are subject to any detectable condition which, in the present state of knowledge, must be regarded as indicative of infective-

ness; and it is impossible to deny that a want of proper regard for this principle may, in particular instances, have led to the premature discharge of patients from hospital, and the consequent reintroduction of disease into their households. But the view that culpable negligence in this respect affords an adequate explanation of "return" cases in general, is difficult to reconcile with what I take it will be conceded as a fact, that "return" cases occur in the practice of the most experienced and careful hospital physicians. Moreover, even if it were proved that "return" cases were mostly due to infection directly given off from the recently returned hospital patient, the attempt to fix the whole of the blame for such occurrences upon the hospital officials takes it for granted:

1. That the processes by which, and the circumstances under which, infection is given off from a scarlatina patient are fully and certainly known.

2. That it is possible, by the exercise of due care, to determine precisely and without doubt the period at which those processes have ceased to operate; in other words, the exact time at which a person has ceased to be infective.

3. That patients who are capable of disseminating infection a week or so after their return home were necessarily, and in all cases, also infective at the time of their leaving hospital.

These, however, appear to be very large assumptions—assumptions, indeed, which involve certain important but difficult considerations in regard to the natural history of scarlatina, to which I propose to refer presently.

Similarly, notwithstanding that "return" cases have doubtless sometimes been due to imperfect arrangements at hospitals for the disinfection of the patients' effects, or to the fact of patients having been allowed, through careless administration, to take with them, on returning home, some infected book or toy, yet the fact that "return" cases occur in connection with hospitals which, judged by our present standards, must be regarded as efficiently equipped and administered, makes it impossible, so it seems to me, to ascribe all cases of the sort to culpable negligence in these respects.

The practice, indeed, of allowing patients, on admission, to bring nothing with them but a night garment—which is destroyed at the hospital, fresh clothes being sent from the home on the day of, and for the purpose of, their discharge—does not seem to entirely prevent the occurrence of "return" cases, even though such fresh clothes are sent

direct to a suitably constructed discharging home, or "outbathing place", and every practicable precaution is apparently taken, short of the absolute sterilisation of the discharge nurse, to prevent these clothes becoming infected on the hospital premises. Further, so far as I am aware, no relation has at present been made out between the character of the procedures adopted at different hospitals in regard to the discharge of patients therefrom and the occurrence in connection with such hospitals of so-called "return" cases. Indeed, so far as importance can be attached to a single observation extending over a comparatively short space of time, the experience of Glasgow in this respect is of some interest. For it appears from the paper of Dr. Chalmers, to which I have already referred, that, during the year 1894, the percentage of "return" cases to dismissals was practically identical at the two principal isolation hospitals in Glasgow, notwithstanding that, as Dr. Chalmers shows, "while patients dismissed from Belvidere are subjected to a carefully designed system of bathing, in a separately constructed 'clearing house' . . . . at Parliamentary Road Hospital there are no discharging-rooms, and the ward bath-rooms (which are to some extent liable to harbour infection) have to be used." It would by no means be safe to infer from this experience that a properly arranged discharging house involves a needless expenditure, and that it does not in some measure tend to diminish the occurrence of "return" cases. I have quoted the experience only as being consistent, as far as it goes, with the view that defective administration of the sorts in question hardly afford an adequate explanation of any large proportion of the total of "return" cases met with.

The kindred suggestion which ascribes "return" cases to insufficient bathing of the patients during the later weeks of their detention in hospital, or to the omission of the frequent application to their bodies of solutions believed to possess disinfecting quality, must for the present, it appears to me, be put aside on similar grounds. I am not aware of any sufficient evidence that the occurrence of "return" cases has been prevented by the use of any particular applications of the kind; and it can hardly be suggested that the generally admitted need for frequent bathing is systematically neglected at our best fever hospitals, or that the employment of any practicable means of ridding the surfaces of the body of infective material would not be adopted were any such means known of.

Coming next to the explanations of the other class to which I have referred, there can be little doubt that the occurrence of a fresh case of scarlatina in a household shortly after the return of a patient from hospital is sometimes a mere coincidence, the fresh case being really due to other causes, such as defective disinfection of the dwelling by the Sanitary Authority, or to some outside source of infection. And that such may be not infrequently the case seemed to me to be indicated by an experience which recently came under my own notice. In that instance a relatively serious number of so-called return cases of scarlatina occurred during a particular period in connection with a country Isolation Hospital—so many indeed as to at first sight represent hospital isolation, as there carried out, in a very unfavourable light, in regard to the limitation of the spread of the disease, as compared with home isolation.

The information obtained, however, sufficed to show that during the period in question the households within this hospital district, from which patients were sent to hospital, suffered as a class much more heavily from secondary invasion, apart altogether from the so-called "return" cases, than the households in the same district in which patients were retained at home throughout the whole period of their illness: a fact no doubt partly due to the circumstance of the former being households of a less well-to-do kind than the latter, and in part also to the further circumstances that the hospital class of households comprised on the average a larger proportion of persons at susceptible ages than the home isolation class. Certain facts, however, appeared to indicate that neither age distribution, nor social condition, sufficiently accounted for the greater incidence of secondary invasion, of kinds independent of hospital operations, upon the hospital class of households than upon the home isolation class; the suggestion from which would seem to be that some other factor or factors of scarlatina production had operated more actively upon the former class than upon the latter. And, so far as the information went, it afforded suggestion that one factor of the kind in question had perhaps been furnished by attendance at particular schools. On the whole it appeared to me probable that some unknown proportion of the so-called "return" cases had, in this instance, been due not to the return of the patients from hospital, but to the cause or causes which had contributed to the excessive incidence of secondary invasion generally upon households of the hospital isolation class. This, I venture to think, is an aspect of the matter that is worthy

of further study as opportunity offers, and, in this connection, the possible influence of school attendance in its relation to alleged "return" cases is, perhaps, especially deserving of attention. The possibility of alleged "return" cases being part and parcel of a milk outbreak, should also of course be borne in mind.

Proceeding with my review of the several explanations to which I have referred, it may, I take it, be concluded that some few of the so-called "return" cases are attributable to the unpacking of some imperfectly disinfected garment in preparation for the return of the patient from hospital; perhaps, as has been suggested, some comparatively new garment which had been intentionally withheld from disinfection lest it should be damaged by the process. But, so far as my experience goes, it has not appeared to me that variations in the occurrence of "return" cases are so closely related to variations in the efficiency with which the disinfection of dwellings and their contents is carried out as to suggest that such cases account for a large proportion of alleged "return" cases. Thus, in the instance to which I have just referred as having recently come under my notice, the largest number of "return cases occurred during the first of three succeeding years. At the end of this first year considerable improvements were adopted in one of the constituent districts of the joint hospital district concerned, in regard to the measures adopted for household disinfection. A steam disinfecting apparatus was provided, and, as I was informed, very special care was taken to secure the thorough disinfection of all articles which could be thought of as having possibly been infected by patients prior to their removal to hospital. Subsequently to the adoption of these precautions a considerable diminution occurred in the number of "return" cases heard of in this constituent district, which might certainly at first sight have been attributed to improved household disinfection. But that the whole of this diminution was not so brought about seemed clear from the fact that a diminution in the number of "return" cases occurred coincidently in the other constituent districts, where similar improvements in disinfecting procedures had not been carried out.

On the whole, then, there can, it appears to me, be little doubt that a proportion of alleged "return" cases are really due to infection in some way re-introduced into the dwelling by the returned hospital patients themselves. And I must confess to some doubt whether the view that such patients operate merely as mechanical carriers of infection by

lodgment of infective material in the hair, or by retention of such material in the lungs, or the aural or nasal passages, can be regarded as sufficient explanation of the facts as observed. At all events, at the joint hospital I have just alluded to, I was assured that special care was taken in regard to frequent washing of the hair; and in order to minimise the risk of recently discharged patients infecting other persons by means of infective material mechanically carried in their lungs, or elsewhere, it was the practice for all patients to pass a fortnight, prior to their leaving hospital, in a detached convalescent block specially provided for the purpose, except in cases where arrangements could be made for sending them to reside for a period in cottages in which there were no children. Finally, when they did return home, a printed notice w ·iven to their relatives warning them that the patients sho..d for a time, as far as possible, be kept apart from other persons.

No doubt the "infective breath" theory presents difficulties, since it is impossible in the present state of knowledge to estimate its influence. But while admitting its probable operation in an unknown proportion of cases, it would, I venture to think, be straining it unduly to regard it as a sufficient explanation of "return" cases generally.

If I am right in the views I have expressed, it follows that some share of so-called "return" cases owe their origin to the actual infectiveness of recently returned patients from isolation hospitals; though it seems to me unlikely, for the reasons I have stated, that the fact of such patients returning home in an infective condition can, as a general rule, be attributed to culpable negligence on the part of the medical officers of such institutions. And if that is so it indicates very clearly our need for further knowledge in regard to the pathology of the infectiveness of scarlatina. Only in proportion as we clearly understand the processes by which infection is given off, will it be possible for us to recognise the termination of those processes. According to a time-honoured and widely distributed belief, the infectiveness of scarlatina is mainly associated with the process of desquamation. This belief, which is still generally held by the medical profession, was recently endorsed by the report of the committee appointed, by the Clinical Society of London, to investigate the periods of incubation and contagiousness of certain infectious diseases, in which it is laid down as regards scarlatina that, "Infection certainly persists as long as there is any desquamation." That a belief so widespread, not only among the public, but also

among those specially trained to the observation of disease processes, is without foundation, seems in a high degree unlikely. There appears, however, to be a growing tendency among certain experienced observers to attach less importance to this source of infection, especially during the later stages of convalescence. That apparently susceptible persons do not necessarily contract disease upon being associated with desquamating scarlatina patients is well illustrated by the significant experience recorded by Dr. Priestly, in a paper read by him before this Society in March last, from which I learn that, owing to an outbreak of small-pox at Leicester, "not less than 120 children, in various stages of desquamation after scarlet fever, were sent to their homes"; and that "no single second case occurred at any of these houses", although Dr. Priestly, in his capacity of Medical Officer of Health, "carefully watched them for three months." And many of us have probably met with experiences of an allied character, though on a smaller scale. It would be rash indeed to conclude from such negative evidence that the process of desquamation is never attended by infective property, especially in view of the weight of opinion and experience on the other side; and I would not for a moment countenance any relaxation in our present custom of urging isolation so long as any desquamation exists—pending at least a fuller knowledge of the pathology of infectiveness in this disease. But it does appear to me that the whole matter requires very careful study; and it seems at least likely that whatever may be the part played by desquamation in this respect, we have hitherto underrated certain other modes by which the infection of scarlatina is disseminated. I refer especially to catarrhal conditions of the nose, ears, and especially of the throat. In so far as it is safe to attach importance to the analogies between scarlatina and diphtheria, it would appear not improbable that the throat plays an important part in the spread of the former disease; and the fact of this channel of infection not, apparently, being more prominently kept in view, may possibly be due to an exaggerated importance attached to desquamation. For instance, it is not unlikely that in endeavouring to trace the origin of fresh cases of scarlatina, the discovery of traces of desquamation upon a recently recovered patient is often in itself regarded as a sufficient explanation of infectivity, and no further sign is sought; whereas, had examination been extended to the throat, other evidence of infectiveness might have been detected.

This appears to be a matter that should be carefully borne in mind in connection with the study of "return" cases of scarlatina.

In view, also, of recent researches in connection with enteric fever, the possible infectivity of the urine of scarlatina patients would appear to be deserving of attention.

As regards our practice, it is easy, however, to say that infectiveness must be presumed to exist so long as any desquamation, or any catarrhal condition of the nose, ears, or throat remain. But, so far as the prevention of "return" cases is concerned, this dictum is by no means altogether satisfactory. For not only are some of the lesions in question apt to become so chronic that the continued isolation of the patient is obviously impracticable; but experience, unfortunately, seems to show that they sometimes recur, and may not, perhaps, even then be without powers of infectivity. This possibility of a recurrence of lesions which may possess infectivity is one of considerable importance in connection with the subject of "return" cases, and is one which should be carefully held in view in passing judgment upon questions of hospital administration in this connection. Whatever may be the significance of the fact in regard to the infectiveness of scarlatina, there can, I think, be little doubt that the process of desquamation, although apparently completed, may be again renewed. And the same appears to be true in regard to the other lesions enumerated. Unfortunately there seems little immediate prospect of bacteriology affording us that measure of assistance in determining the infectivity or otherwise of such recurrent manifestations in the case of scarlatina that it promises in regard to diphtheria; but that appears to be an additional reason for close study of the matter in its clinical aspects, and the subject is one upon which I would especially invite the opinions of members of this Society.

I should next wish, by way of suggestion, to briefly direct your attention to certain considerations which may perhaps have a bearing upon the occurrence of "return" cases of scarlatina. In the series of cases to which I have already on several occasions referred, there appeared to me some indication of the operation of a seasonal influence; the "return" cases occurring most frequently, relatively to the number of dismissals, in connection with patients who were discharged during the latter half of the year. I also noted that, relatively to the number of dismissals, such

cases occurred most frequently during the rise of the epidemic. It would be unsafe, of course, to draw definite conclusions from experiences of so limited a character, but, so far as they go, they are not inconsistent with the notion that the occurrence of "return" cases may be in part regulated by variations in the infectivity of scarlatina, or the receptivity of individuals, at different times, including, perhaps, cyclical variations extending over considerable periods, such as those to which Dr. Whitelegge has so ably directed attention in respect of certain of our indigenous diseases. In any case, these appear to be questions worthy of attention in the future study of "return" cases of scarlatina.

A matter of more immediate practical importance, upon which also we require more extended observation, is the possible operation of over-crowding of hospital wards as a factor in the production of "return" cases. As a result of his investigations in Glasgow, Dr. Chalmers appears to have been led to the conclusion that prolonged overcrowding of wards does conduce to the occurrence of such cases, and I have myself seen reason to regard overcrowding with suspicion in this respect. Whether its operation, if it does operate in the direction suggested, is due merely to the circumstance that the lungs of patients leaving overcrowded hospitals are charged with more highly infective air than would otherwise be the case, or whether the surcharging of the ward atmosphere with infective material tends in some way or other to prolong the period of infectiveness of patients residing therein—owing, perhaps, to their undergoing slight reinfections, as suggested by Dr. Boobbyer—is a difficult question. In regard to the matter, Dr. Chalmers remarks that "it would appear that apart from the possible return of readily recognisable conditions such as desquamation, etc., after dismissal, there is a constitutional effect produced which renders the discharged convalescent a danger to susceptible persons who may be brought into close contact with him. That this results from saturation of the system is, I think, clear; but whether it is due simply to delayed elimination, or to constant breathing of a saturated atmosphere by the convalescent, is matter for conjecture."

Dr. Chalmers further refers to the fact brought out by Dr. Sweeting as to the increased frequency in the occurrence of albuminuria which results from the aggregation of acute cases of scarlatina, as perhaps bearing on the point in question.

Before concluding, there is one point in regard to the investigation of "return" cases upon which the opinions of members of this Society would be very helpful. I have frequently referred to such cases as occurring shortly after the return of patients from hospital. In statistical inquiries into the matter, however, it will usually be necessary to fix some time limit within which cases occurring after the return of patients may be reasonably classified as possible "return" cases: cases occurring later being excluded on the ground of their being more probably due to fresh sources of infection. And the question is as to the time limit that should be adopted. This has sometimes been fixed as twenty-one days, and I think it will be agreed that if we err in adopting that period we err on the side of liberality; for I observe that 9.3 per cent. of Dr. Chalmers's cases, which seemingly included all cases heard of, occurred within a fortnight after the dismissal of the patients from hospital. It has also to be remembered that the period of incubation of scarlatina is usually less than three days, and practically always less than eight. On the other hand, it of course by no means follows that a fresh case was infected immediately on the arrival of the hospital patient in the dwelling, especially if such case resulted from a recurrence of infectivity on the part of the hospital patient. On the whole, therefore, I am disposed to think that the period of twenty-one days, if somewhat liberal, is perhaps a not unreasonable one for statistical purposes. But besides what I may call this far time limit, a near time limit will also be required. In this respect it would, perhaps, be sufficient to exclude all alleged "return" cases occurring upon the day of the arrival of the patient from hospital.

And now, Gentlemen, briefly summarised, the view which I have endeavoured to put before you is, that although a certain proportion of "return" cases may of course at divers times and places be due to carelessness in the discharge of patients, or to other form of culpable maladministration, whether on the part of the hospital officials or those responsible for the disinfection of the patients' dwellings and effects, there are, nevertheless, in all probability some more obscure factors at work—factors, perhaps, closely bound up with the natural history of scarlatina.

DIPHTHERIA IN OLDER AND NEWER BRISTOL.

(Notified Cases for the Five Years, 1890-94.)

By W. DOWSON.

(*Read: December 13th*, 1895.)

For the purpose of the following remarks upon the history of diphtheria in Bristol during the past five years, 1890-94, the city has been divided into two parts, an older and a newer part, each containing five registration sub-districts. Older Bristol includes the sub-districts of St. Mary Redcliff, Castle Precincts, St. Paul, St. James, and St. Augustine; and is, in fact, the old city of Bristol prior to the extension of its boundaries under the Municipal Corporations Act of 1835. Newer Bristol is made up of the districts of Bedminster, Clifton, Ashley, St. Philip, and Westbury; and forms a continuous though irregular zone round the older part.

To show the relation between these two parts of the city, I have had prepared a map which, roughly but accurately enough for the purpose in hand, contrasts Bristol of 1850 with Bristol of 1891. Older Bristol, as constituted by charter of King Henry VIII, and containing the districts just enumerated, is unshaded, its extent being indicated by a thick slightly broken black line. Newer Bristol is represented by shading, the 1835 boundary appearing as a dot-and-dash line. Certain areas in newer Bristol, near the present municipal boundary, which are not yet built upon, are indicated by dark shading.

The outlying parts of the city in 1850 appear as unshaded patches outside the thick boundary line, and contribute an old nucleus to each of the districts which together make up present-day newer Bristol. The map shows that these districts have overflowed the 1835 boundary line and, to a considerable extent, are in continuity with an outside population which in 1850 was represented by scattered farmsteads, country mansions, and small villages, separated from Bristol at that date by fields and cultivated lands. This outside population,

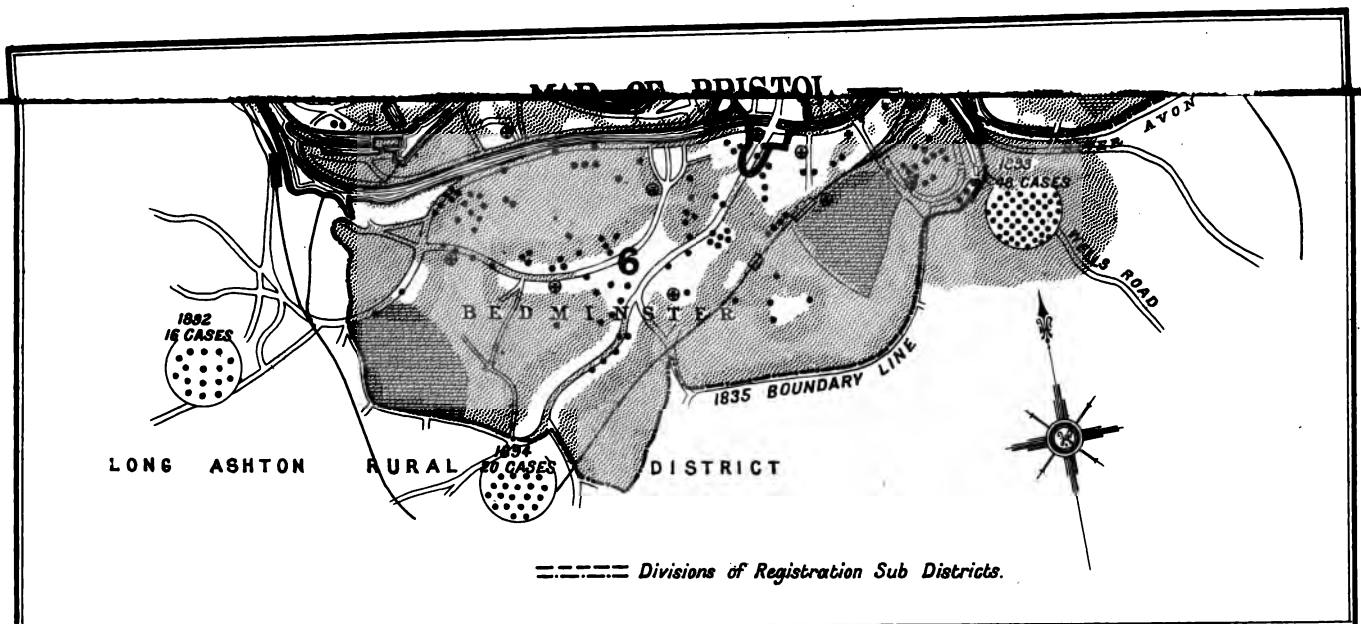
inhabiting houses and streets in direct continuity with the streets of Bristol, numbers to-day over 60,000 persons, and, together with the city as defined by the 1835, *i.e.*, its present municipal boundary, constitutes a greater Bristol, which practically is one large town, with a population of about 300,000 persons.

Only a few main thoroughfares are lined in the map, relatively more in the old city; it should, however, be understood that, with the exception mentioned, shading indicates masses of houses and other buildings. All the unshaded parts representing old Bristol and its outlying parts in 1850 are also thickly built over. To assist the readier comprehension of the Tables, I have numbered the older districts 1—5, and the newer 6—10; and will from this point refer to each by its distinctive number.

TABLE I.

Registration. Sub-Districts.	Population. Census. 1851.	Population. Census. 1891.	Factor.
1. Redcliff	14,380	9,292	
2. Castle	11,076	5,595	
3. St. Paul	15,280	19,036	
4. St. James	10,658	7,831	
5. St. Augustine	14,322	13,795	
Older	65,716	55,549	
6. Bedminster	17,598	45,627	2.6
7. Clifton	17,634	29,345	1.7
8. Ashley	7,935	24,024	3.0
9. St. Philip	24,961	51,624	2.0
10. Westbury	5,692	15,391	2.7
Newer	73,820	166,029	
Total	139,536	221,578	

In Table I, the populations of the various sub-districts are placed side by side, and from this it appears that the population of the old city has decreased, while that of newer Bristol has increased by between 80,000 and 90,000 persons. The last column in this Table gives the factor of increase in the newer districts. It will be noticed that one of the districts of the old city, No. 3, has increased in population, and a reference to the map shows that this district has a peculiar relation to newer Bristol, jutting into it like a peninsula: this also happens to be the only


MAP OF BRISTOL
AVON
1833
48 CASES
FALLS ROAD
6
BEDMINSTER
1892
16 CASES
1835 BOUNDARY LINE
LONG ASHTON RURAL
1894
20 CASES
DISTRICT
Divisions of Registration Sub Districts.

district of older Bristol which contains a fairly large number of more or less new dwelling houses. As a contrast to this district I would ask you to notice in Table I that districts 7 and 9 in newer Bristol contained, in 1851, half their present population—No. 7 not quite half; and that, as the factors show, these two have increased relatively less than the other newer districts.

It will be admitted, I think, that the two parts of Bristol which are to be contrasted as regards diphtheria incidence, are not the result of an arbitrary division adopted merely for the purpose of statistical calculations: they possess an integrity depending not only upon the age of their component districts, but also upon the fact, that the addition of close upon 100,000 persons to the population has taken place in one of them (newer Bristol), which further, and partly in consequence of this, contains almost the whole of those interminable rows of workmen's dwellings such as have been erected during the course of the past thirty years or so on the outskirts of most large cities.

During the five years 1890-94, 501 cases of diphtheria, including membranous croup, were notified as occurring in houses in the various registration sub-districts of Bristol. Of these 162 died, giving a case mortality of 32.3 per cent. None of the cases were removed to hospital for isolation purposes, and, so far as I can learn, the expectorated matter and excreta in the majority of the cases reached the sewers without previous sterilisation. In Table II, the cases occurring each year are allotted to age periods and the mortality per cent. is shown. It appears that the annual incidence of diphtheria upon persons over fifteen in Bristol during that period was fairly constant in amount, but that the increased prevalence which the annual totals show to have occurred year by year, was the result almost entirely of increased incidence of the disease upon those under fifteen, the greatest stress falling upon children between the ages of three and ten. Seventy-two per cent. of the total cases occurred amongst those belonging to the age group 0-15, with a case mortality of 42 per cent. The disease was most fatal by far to children under three. The increase in the fatality of the disease, as shown at the foot of the Table, by calculation upon the annual totals, is evidently the reflection of the heavy death tax upon the children under ten. On the whole, the indications afforded by this Table agree closely with those of Mr. Shirley Murphy's Table dealing with the same subject in his report of 1893.

TABLE II.

Notified Cases of Diphtheria arranged in Age-Periods.

C. = Cases. D. = Deaths.

Age Periods.	1890.		1891.		1892.		1893.		1894.		Total.		Case Mortality per cent.	Annual Average No. of Cases.
	C.	D.	C.	D.	C.	D.	C.	D.	C.	D.	C.	D.		
Under 1.	1	0	2	1	3	3	10	5	9	8	25	17	68 } 63	
1	3	2	4	1	9	5	13	8	8	5	37	21	56	
2	4	1	3	2	7	4	13	12	7	4	34	23	67	
3	7	5	6	3	10	2	9	5	15	7	47	22	47	
4	10	5	5	1	7	3	13	7	12	6	47	22	47	
5	20	3	17	4	23	11	39	14	30	12	129	44	34	
10	2	0	6	1	11	2	11	0	13	2	43	5	11	
—15	47	16	43	13	70	30	108	51	94	44	362	154	42	72.4
15	4	1	3	0	14	2	9	0	7	0	37	3	8	
20	5	0	10	0	6	1	6	0	5	1	32	2	6	
25	2	0	4	0	5	0	4	0	3	0	18	0	—	
30	4	0	3	0	5	0	6	1	7	0	25	1	—	
40	5	0	1	0	3	0	2	0	3	0	14	0	—	
50	—	—	4	0	3	1	1	0	—	—	8	1	—	
60	—	—	2	0	1	1	2	0	—	—	5	1	—	
15 +	20	1	27	0	37	5	30	1	25	1	139	8	6	27.8
	67	17	70	13	107	35	138	52	119	45	501	162	32.3	100.2
All ages. Case mortality per cent.	25		18		32		37		37					

$$\frac{362}{501} = \frac{72}{100}$$

Table III distributes these 501 cases amongst the various registration sub-districts, and contrasts at the same time the incidence upon older and newer Bristol. It will be noticed that the population of newer Bristol is almost exactly three times that of the older part. At the foot of the Table I have placed the annual totals for newer Bristol underneath the corresponding figures for the old city, after multiplying these latter by three, thus roughly allowing for the difference of population in the two parts.

A consideration of this Table appears to bring into relief several important facts, the first to catch the eye being that diphtheria has been decidedly more prevalent in the

newer than in the older part; and that whereas with the exception of the last year of the period, the incidence upon the older part has not varied much, that upon the newer part has varied considerably and progressively. The figures show that increased prevalence of diphtheria in Bristol has been chiefly the result of an increase in the number of cases in those registration sub-districts which make up the newer parts of the city.*

TABLE III.

Notified Cases of Diphtheria in Bristol for the Five Years 1890-4.

REGISTRATION. Sub-Districts.	POPULATION. Census, 1891.	1890.	1891.	1892.	1893.	1894.	Total Cases.	Average Annual No. of Cases.	Corrected Incidence. Rates per 1,000.
1. Redcliff ...	9,292	2	5	1	4	3	15	3	.32
2. Castle ...	5,595	1	0	3	2	4	10	2	.39
3. St. Paul ...	19,036	9	5	5	5	15	39	7.8	.41
4. St. James ...	7,831	3	1	0	5	2	11	2.2	.30
5. St. Augustine	13,795	1	4	8	4	2	19	3.8	.27
Older ...	55,549	16	15	17	20	26	94	18.8	.34
6. Bedminster .	45,627	9	7	32	45	30	123	24.6	.49
7. Clifton ...	29,345	9	10	11	15	10	55	11	.43
8. Ashley ..	24,042	15	12	12	15	21	75	15	.62
9. St. Philip ...	51,624	9	12	20	25	24	90	18	.32
10. Westbury ...	15,391	9	14	15	18	8	64	12.8	1.00
Newer ...	166,029	51	55	90	118	93	407	81.4	.49
Whole City ..	221,578	67	70	107	138	119	501	100.2	
Older (Recorded Cases × 3) ...	...	48	45	51	60	78	282		
Newer	...	51	55	90	118	93	407		
Long Ashton (Rural District)	26,000	11?	10	16	48	20	105	Outside Districts adjoining Bristol.	
St. George (Urban District) ...	36,718	8	8	24	11	20	71		
Stapleton (Urban District) ...	16,000	?	?	?	?	23	?		
Barton Regis (Rural District)	14,460	2	8	12	10	16	48		

* Subsequent note :—The figures for 1895 show a still greater disparity between Older and Newer Bristol as regards diphtheria incidence. Out of a total of 163 cases, 144 occurred in the Newer, and only 19 in the Older part.

The next point which appears is that the increase in older Bristol in 1894 (the total for that year being twenty-six cases as against twenty for 1893) was evidently the result of a relatively large increase of cases in No. 3 district, which had fifteen as against five in the previous year, an increase which tended considerably in the direction of reducing the contrast between the older and newer parts; and, as if to indicate that this was not an accidental occurrence, the figures for 1890, the first year of the period, when the contrast between the number of cases in the newer and older parts was at its lowest, show that this district again furnished more than half the total cases occurring in the older part, viz., nine out of sixteen. That the district which had such an influence as this upon the relative incidence of the disease upon the two parts of the city, should be the only district in the old city which has increased in population, and which, as I have pointed out, has a peculiar relation to newer Bristol, projecting into it like a peninsula, seems to me a decided indication, so far, that the disparity between the two parts of the city, as regards diphtheria incidence, has to do with some real difference between these parts. It has, no doubt, been noticed (what I should have pointed out before) that the contrast between the two parts of the city is not merely one of the annual average number of cases for each part: the difference appears in every year of the period, and most of all in the year 1893, the year of greatest prevalence, when, presumably, the opportunities of inter-infection between the two parts were at their highest.

Turning now to the part of the Table dealing with newer Bristol, an examination of the figures shows that the decided increase in the number of cases for 1892 was due almost entirely to an increase in the two districts 6 and 9, and, further, that the decrease in 1894 was associated with a decrease in the same two districts. The only district in which a decrease in the number of the cases did not take place in 1894 was No. 8 district, which not only did not participate in the general decrease, but presented a decided increase of cases. This district has, with the exception of No. 10 district, by far the highest diphtheria rate in the whole of Bristol; and is the one into which district No. 3 of the older part projects like a peninsula, and which in this same year showed such a large increase of cases. There can be little doubt, I think, that the incidence of the disease upon these two districts is somehow associated, and that were it not for this association, the contrast between

the older and newer parts would have been still more marked.

Before dwelling any further on this contrast it is necessary to correct the figures in Table III for age distribution; seeing that Table II shows that 72 per cent. of the total cases occurred in persons under fifteen. Moreover, the various sub-districts present considerable differences in their birth-rates, and are known to vary considerably as regards their respective ratios between the number of persons under and over fifteen. The districts 7 and 10 are residential districts, inhabited chiefly by well-to-do people, and contain far more domestic servants, more unmarried people, and more aged persons than any of the other districts.

Table IV, accordingly, gives an average population of each registration sub-district, divided into two age groups containing those under and those over fifteen years of age; the incidence of the disease upon an average population of the whole city for the same groups; the recorded incidence rate, the factor, and the corrected rate. I have chosen the census figures for 1891 as representing with sufficient accuracy an average population of the five years, instead of estimated figures for 1892, the middle year of the period, although the result has been a slight magnification of the contrast which is my main theme. The increase in 1892 of a number under 2,000 to the total population of the city, was laid on almost entirely in two districts of newer Bristol, Nos. 6 and 8; and, if taken into account, would make a difference, in the case of district No. 6, of barely 1, and in district No. 8 of exactly 2, in the second decimal place. The correction has caused considerable alteration in the rates of several of the districts, in the direction that was expected; but none in those of the two larger divisions of the city which are contrasted.

Newer Bristol is thus shown to have a corrected average incidence rate of .49, and older Bristol one of .34 per 1,000 persons living, rates which would assign, out of every 100 cases, 60 to the former, and 40 to the latter. In other words, for every two cases that on an average have occurred in older Bristol, three have occurred in the newer part. In 1893, the year of greatest prevalence, the incidence upon the latter was just double that of the former. I would finally point out that whereas district No. 3 in the old city contains more new dwelling-houses, and has a higher diphtheria rate than any of the other districts with which it is placed, district 9 in newer

Bristol contains less new dwelling-houses, and has a lower rate than any of the districts with which it is grouped.

TABLE IV.

Diphtheria Incidence Rates per 1,000 *Population living. Census Population of* 1891 *taken as Average Population for the Five Years,* 1890-4.

REGISTRATION. Sub-Districts.	POPULATION.		Average Annual No. of Cases.	Average Annual Recorded Incidence Rates per 1,000.	Factor for Age-Distribution.	Corrected Incidence Rates per 1,000.	Average Annual Corrected Cases.	Average Persons to each Inhabited House.	Average Persons to an Acre.
	– 15.	15 +.							
1. Redcliff ...	3,160	6,132	3	.32	1.02	.32	—	5.9	54.6
2. Castle ...	1,670	3,925	2	.36	1.10	.39	—	7.7	46.7
3. St. Paul ..	6,593	12,443	7.8	.41	1.00	.41	—	6.4	128.6
4. St. James .	2,475	5,356	2.2	.28	1.07	.30	—	6.7	114.9
5. St. Augustine	4,596	2,199	3 8	.29	1.02	.27	—	7.5	55.1
Older ...	55,549		18.8	.34	1.02	.34	40	6.7	73.5
6. Bedminster	17,633	27,994	24.6	.53	0.93	.49	—	5.7	46.1
7. Clifton ..	7,959	21,386	11.0	.37	1.18	.43	—	7.2	31.8
8. Ashley ...	8,591	15,451	15.0	.62	1.00	.62	—	6.2	55.7
9. St. Philip .	19,962	31,662	18.0	.35	0.93	.32	—	5.9	69.6
10. Westbury .	3 843	11,548	12.8	.83	1.21	1.00	—	6.0	22.4
Newer ...	166,029		81.4	.49	1.00	.49	60	6.1	43.7
Whole City ..	221,578		100.2	.45			100	6.2	48.9

Age-Periods.	Average. Population.	Average Annual Cases.	Rates per 1,000.
– 15	76,482	72.4	.94
15 +	145,096	27.8	.19
All Ages	221,578	100.2	.45

It was a remark of Dr. Newsholme's, in the course of a discussion on "The Causes of the Increase of Diphtheria in Urban Districts", at the Newcastle meeting of the British Medical Association in 1893, which led me to think that a careful consideration of the cases notified in Bristol during a period of five years, might afford some useful indications, either positive or negative, with respect to some of the points then raised.

The opener of the discussion, Dr. Sidney Davies, in

contrasting diphtheria incidence upon older Woolwich with that of newer Plumstead, which "is in reality merely an extension of the former", had pointed out that these two districts differed in age, in the character of their sewers, both as to structure and ventilation, and in their general healthiness; and strongly advocated his two main propositions that Plumstead had a higher diphtheria incidence than Woolwich, because its new sewers were ventilated by grids at the street level, whereas the old sewers of Woolwich were not so ventilated; and that, probably, the ventilation of sewers was one, if not the chief, cause of the urban increase of diphtheria generally. Commenting on this, "Dr. Newsholme was of the opinion that a more probable explanation of the increased prevalence of diphtheria than the sewer grids, would be found in the very defective house-drains which had been laid in suburban districts during the last thirty years", and that "this might explain the greater prevalence in Plumstead than in Woolwich, which was an older district". Dr. Newsholme, however, went on to say that "the chief cause of diphtheria was . . . . personal infection". I have omitted to state that, in support of his view, Dr. Sidney Davies drew a comparison between towns such as Brighton and Croydon, in which careful ventilation of the sewers had been followed by outbreaks of diphtheria, and Bristol, which, with unventilated sewers, has very little diphtheria.

The sewers of Bristol are tide-locked twice in every twenty-four hours: they "take all storm water, which reaches them by way of trapped street gullies"; and "are without any external openings or ventilating outlets" . . . "The manholes are all closed down. In the low level sewers provision has been made for flushing from the floating harbour, and double tidal valves are fixed at their outlet."

It would be a mistake to take it for granted that non-ventilation of sewers in Bristol implies absence of exposure of its inhabitants to sewer air. In the course of the past thirty years or so, the great majority of the houses that have been built in Bristol are workmen's dwellings, disposed in long dreary rows in the style familiar to everyone, each house being provided with a small open space at the back containing the privy, which is without any flushing apparatus. With comparatively few exceptions these privies, the pans of which are of various kinds and shapes, but all fixed to traps containing, or supposed to contain, a water seal, are connected with the street sewer by a drain passing under the house, and without any disconnection

from the sewer. Although the drains run under the house they are not laid in concrete or treated in any special way; and the result of this arrangement is that defective joints provide a ready means for sewer air to reach the interior of the house. In most parts of newer Bristol, but especially in districts 6, 8, and 9, there are large areas thickly covered by many hundreds of houses of this description; and it is a fact that whether as the result of complaints, or of examination by the inspectors of the Public Health Department, of premises in which infectious disease has occurred, newer Bristol has yielded relatively more sanitary defects, and these of the graver kind, than older Bristol. Our experience in Bristol fully bears out the general experience that a great deal of faulty drainage work has been put down in the course of the past thirty years.

As an illustration of this, consider the five years, 1890-94, with which I am dealing. During this brief period the drains of 2,526 houses have been entirely reconstructed, and those of 6,518 have been partly reconstructed; and of this drain reconstruction work dealing with, in all, 9,044 houses, a number approaching to close upon one quarter of the total houses in Bristol, more than three-quarters was carried out in the newer parts of the city.

In every one of these 9,044 houses the defects in the drains were of such a nature that sewer air or drain air, or both, escaped either into the house, or close to it, more or less freely. Considering that "drains out of order" is quite the most common complaint at the Offices of our Public Health Department, and that for some time past so large a proportion as 30 per cent. of the total complaints have been found to require no attention, it seems not improbable that this number represents fairly accurately the number of points affording opportunities of exposure of the inhabitants of Bristol to sewer air in or about houses during the past five years. Were these houses, to any notable extent, specially selected for the manifestation of diphtheria amongst their inmates?

There are altogether about 37,000 inhabited houses in Bristol, so that over the period of five years under consideration, and for the purpose in hand, the 9,000 and odd houses just referred to may be called sewer-air-houses, and the remaining 28,000 non-sewer-air-houses. The 501 diphtheria cases occurred in 437 houses, 125 of which, or 28.6 per cent., presented sanitary defects of various kinds. Of these 125 defective houses 71 were sewer-air-houses, according to the description just given, that is to say, their

drains were in such a faulty condition that they had to be either wholly or partly reconstructed. The remaining 366 of the total 437 diphtheria-invaded-houses fall, consequently, into the class non-sewer-air-houses. As the result of a simple calculation (shown in Table V) by means of these figures, it appears that 8 per 1,000 of the total sewer-air-houses were invaded by diphtheria, as against an invasion of 13 per 1,000 of the non-sewer-air-houses.

TABLE V.

Comparing the Incidence of Diphtheria on Sewer-air and Non-sewer-air Houses.

Total Houses invaded by Diphtheria, 1890-4 ... 437.

Defective houses	125	Sewer-air houses	71
Non-defective houses ...	312	Non-sewer air houses ...	366
Total	437	Total	437

Total houses in Bristol (estimated)	37,000
Sewer-air houses	9,000
	28,000

Incidence of Diphtheria upon sewer-air houses—

$$\frac{71 \times 1{,}000}{9{,}000} = 8 \text{ per } 1{,}000.$$

Incidence of Diphtheria upon non-sewer air houses—

$$\frac{366 \times 1{,}000}{28{,}000} = 13 \text{ per } 1{,}000.$$

If this is an unexpected result, I should like to point out that any increase of the 9,000 total sewer-air-houses would result in a still greater disparity between these ratios. I believe, however, that these figures fairly indicate the extent of sewer-air influence upon the manifestation of diphtheria in Bristol, after making due allowance for the undoubted fact that the disease is infectious, and taking into account the further fact that there being so many more non-sewer-air than sewer-air-houses, the element of chance would play some considerable part in determining a relatively higher incidence upon the non-sewer-air-houses. If it had been possible to ascertain exactly in how many instances sewer air had escaped directly into the interior of the house, a more accurate estimate of the amount of its effect would have been possible; and this I had hoped to be able to do. Unfortunately, the records of the work oftener than not left this point uncertain: but in order to prevent, if possible, a wrong interpretation being put upon the figures, let it be assumed that

the whole of the 125 defective houses in which diphtheria occurred were sewer-air-houses, thus leaving only 312 non-sewer-air-houses out of the total of 437 invaded by diphtheria. Although this assumption entirely gives away the case for the non-sewer-air-houses, the result of a similar calculation assigns to the sewer-air-houses an incidence of 14, and to the non-sewer-air-houses an incidence of 11 per 1,000. Adopting even this last calculation as a closer representation of the facts, these figures are hardly, I think, such as would be expected, if sewer air had played any large part in determining the onset of diphtheria attacks in Bristol. Whatever value the figures may possess, it should be remembered that the fact of the Bristol sewers being unventilated, makes it possible to locate, to a considerable extent, the points where sewer air escaped; and sewer air inside or close to a house would, I take it, act with greater certainty, in any way in which it can act as a factor in disease causation, than sewer air which has escaped into the open street. As a matter of fact, when the sewers are tide-locked pressure is relieved by the forcing of traps at various points, and the street gullies take their share; but on the whole, and for the subject in hand, sewer-air-houses in Bristol can be properly considered as specially selected points, and should show relatively a considerable excess of diphtheria attacks over those which occur in non-sewer-air-houses, if the manifestation of the disease were governed to any important extent by the sewer air influence factor.

It is possible to advance as an objection to the comparison which has been drawn, that the ample fall in the Bristol sewers, and their frequent flushing by storm waters, make it probable not only that the diphtheria virus which they continually receive is quickly removed, but also that the sewer air, *quâ* its other constituents, would not be expected to possess that hurtful quality which the sewer air in some towns is believed to possess; and that, therefore, any comparison of disease incidence in Bristol, between houses exposed to sewer air influence and those not so exposed, is valueless. Assuming this to be so, the same consideration would prevent any comparison which turns on the question of ventilation alone, between Bristol and other towns where the sewers are not so clean.

It may further be reasonably advanced, I think, that assuming the sewer air of Bristol to be capable of exerting the same kind of influence which is imputed to that of other towns, yet the numbers are too small—that an

average of $\frac{2000}{5}$, or about 2,000 points of sewer air influence distributed over a year of time, cannot give a correct indication of the operation of this influence on the manifestation of diphtheria. Fortunately for the consideration of this subject, but very disastrously for a large number of people in Bristol, an event which provides an experiment on a large scale to this very point, occasionally occurs in the city. In times of exceptionally heavy rainfall, certain thickly inhabited portions of the city on each side of the river Frome have been flooded to such an extent that large areas were under several feet of water, a condition of things lasting sufficiently long to necessitate the use of boats for the purposes of communication and for the conveyance of provisions to the marooned inhabitants. This happened in March 1889, and again in November 1894, both occasions within my own experience. The pressure in the sewers was so great that the traps of street gullies, yard gullies, and of w.c.s were forced, with the result that on the subsidence of the flood, a layer of mud, largely charged with sewage matters, was deposited not only in streets and yards, but in cellars and ground floor living rooms. The districts which suffered most from these floods are, in order of severity, those numbered 8, 3, and 9; and whereas previous to the flood in 1894, diphtheria had affected quite other parts of the city, the occurrence of this was at once followed by increased incidence of this disease upon these districts. Out of a total of twenty-seven cases which occurred in the whole of the city in the course of the six weeks immediately following the flood, no less than twenty-two were found in these districts, and of these the majority occurred in those numbered 8 and 3. That this association of diphtheria incidence with sewer conditions was not accidental, seems to me a fair inference; but here again, considering the large number of children and young persons that were exposed to sewer-air influence under the most trying circumstances, the increase, to my mind, was not of that magnitude one would expect if the appearance of the disease were controlled, to any great extent, by this influence.* As an indication on the other hand that sewer air influence is, under certain conditions, a predisposing factor in the manifestation of the disease, this experience

* The prompt measures taken for rendering the deposited filth innocuous had probably some connection with this result. A large staff of men was temporarily engaged to deal with it; and within tweuty-four hours after the subsidence of the flood, all the deposit had been covered by a disinfectant, and much of it removed.

is, I think, of some value: although under ordinary conditions, in Bristol, with an average of about 2,000 opportunities every year for its operation, its effect, if the sewer air influence figures I have adduced give a true indication, is either scarcely noticeable or nothing at all.

Considering that there is such a decided excess of diphtheria in newer as compared with older Bristol, it might almost seem unnecessary to ask the question, "Have the majority of the cases occurred in the newer houses"? and I must confess that I came near taking it for granted that this was so. But as the supposition that excessive prevalence of diphtheria in newer districts may be in some way intimately associated with the faulty drainage of newer houses, derives its main support from the assumption that sewer air influence is a real and important factor in the manifestation of the disease, the failure of the sewer air influence figures to afford this general proposition any material support, made it advisable to look at this point more closely.

I accordingly wrote out a list of the addresses of the 446 cases which had occurred in the districts containing newer houses, *i.e.*, in all the districts of newer Bristol and in district 3 of the older part; and submitted this to the City Surveyor, who kindly undertook to mark all the houses over thirty years old or thereabouts, a period of time which would afford the sharpest contrast between the two classes, and which was chiefly associated with that large and rapid increase of population to which I have referred. The result of this, which came upon me as a surprise, is set out in Table VI, from which it appears that the disease has in every instance but one invaded older and newer houses in a degree roughly corresponding with the relation between the numbers of the 1851 populations and the 1851-91 *increments* to these (see Table I). Assuming that the ratio between these population numbers affords some indication of that between older and newer houses, as defined, it would appear that the extent to which the latter have been invaded has been influenced by the proportion in which they exist in each district.

Number 10 district provides the exception which is instructive. This is the district which, after district 8, has increased relatively more than any other part of Bristol; and yet in plain contradiction to the dot map, the Table makes older houses to have suffered more than newer houses. The explanation is that this was the first of the districts of newer Bristol to feel the tide of increase which set in about the year 1855; its rise being marked by such

TABLE VI.

Showing the number of Newer and Older Houses which were invaded by Diphtheria in all the Districts containing newer houses.

DISTRICTS.	No. of Older Houses.	No. of Newer Houses.	Totals.
3. St. Paul	22	12	34
6. Bedminster	37	72	109
7. Clifton	16	32	48
8. Ashley	24	39	63
9. St. Philip	44	40	84
10. Westbury	27	23	50
	170	218	388
No. of Houses invaded in remaining four Districts of Old City.	49		
	219		
			388
			49
Total Houses invaded by Diphtheria, 1890-4			437

a rapidity of growth that a considerable part of it was built in the ten to fifteen years just prior to the thirty-year period adopted for the classification of the diphtheria houses into older and newer. With a forty instead of a thirty years' limit more newer than older houses would be shown to have been invaded. The necessary correction for this makes the numbers of the older and newer houses nineteen and thirty-one respectively. The figures for district 9 might be taken almost to decide the question which has been raised. This is the one district in Bristol in which the total houses are somewhat evenly divided into "older" and "newer"; and here it is that the diphtheria cases are distributed nearly equally between these two classes of houses. The fifty-five cases of diphtheria in the remaining four districts of older Bristol, occurred in forty-nine houses. Adding these to the 170 older houses shown in the Table, it would appear that the total of 437 diphtheria invaded houses, is made up of 219 older and 218 newer houses. Introducing the correction for district 10, the corresponding numbers would be 211 and 226; showing that the newer were invaded to a slightly greater extent than the older houses. The disparity, however, is scarcely so great as to warrant the inference that any conditions which attach to such a difference in the age of

houses as has been indicated, have been intimately connected with diphtheria incidence.

If my interpretation of the facts and figures which have been placed before you makes in the right direction, the position is this: a relatively greater incidence of diphtheria upon suburban, or newer, Bristol has had little to do with either sewer air influence or some other unknown conditions of dwelling houses which depend upon a difference in their age of about thirty years.

It would appear then, after all, to be a matter of areas—that there is some peculiarity of the newer districts which favours diphtheria incidence; and the question naturally presents itself, is there anything in the geological formation, the character of the industries, the people themselves, the topographical position or general character of the areas which could possibly affect the distribution of this disease?

Broad geological features as such have certainly not influenced the distribution. The Bristol area is classic ground for the geologist; and the question of any such influence is, if I am not mistaken, sufficiently settled in the negative, to justify me in saying no more upon the subject.

As regards dampness of dwelling, I can state with confidence that this all-important factor in diphtheria distribution has played little or no part in Bristol. With the exception chiefly of certain areas on each side of the river Frome, and these only in the exceptional times of flood, the city is an eminently dry one. Of the 437 invaded houses, only fifty altogether were described as damp, rather damp, or fairly dry, and the majority of these were not situated in the districts liable to flooding.

As regards industrial conditions, I am not aware of any material difference between the two districts. A consideration of such conditions in factories as cubic space, light, ventilation, and sanitary conveniences, would show, I think, that newer contrasts favourably with older Bristol. Looking at the industries themselves, it is a fact that most of the slaughter-houses and offensive trades are to be found in newer Bristol; but I am not aware that it has ever been shown that those engaged in such occupations suffer excessively from diphtheria.

It remains to be considered if there is anything peculiar about the inhabitants of newer Bristol, or about the areas in which they live, which might account for their liability to suffer from this disease to a greater extent than the inhabitants of the older part; but before attempting this I should like to state to what extent school children have

suffered, and represent correctly to you, if I can, the manner in which the disease has affected the city generally.

Of the 501 total cases, 362 occurred in children under fifteen years of age; and of these, 154, or about three-sevenths, were attending school at the time of their attack. These 154 children were distributed among 101 schools, 31 being divided between 28 private schools, and 123 attending the public elementary schools, of which there are 73.

Of these 123 cases, 23 attended schools in older and 100 in newer Bristol. I have already shown that of every 100 cases, forty would fall in the older and sixty in the newer part. Multiplying twenty-three by three to correct for the difference of population, the ratio between the number of attacks in school children in older and newer Bristol is expressed by the fraction $\frac{69}{100}$, and this is nearly proportional to the fraction $\frac{66}{100}$, or $\frac{40}{60}$, which expresses the ratio between the total attacks in these two divisions of the city. Considering that 72 per cent. of the total attacks for the whole city occurred in children of or about school age, this is as it should be, if the two parts of the city contrasted did not require a correction for age distribution.

Not one of the 101 schools escaped without a case of diphtheria amongst its scholars in the five years, but as many as seventy-six of them had each only one case during this time. Only five schools had an average of one or more than one case per annum during the same time, the actual numbers being five, seven, eight, eleven, and thirteen. With the exception of the school in connection with which the thirteen cases occurred, only five schools in all had cases occurring sufficiently near each other in point of time to render it probable that the second case in each instance, every one of which contained no more than two cases, may have been connected with the first by way of infection.

The thirteen cases occurred during the floods at the end of 1894, amongst the children attending St. Barnabas Parish School, which is situated in district eight, and has 741 names on its register, with an average attendance of 651. This school draws its scholars from the districts eight and three, is overcrowded, and at the time when the cases occurred, provided w.c. accommodation of the worst description—old-fashioned hopper basins without flushing apparatus, urinals unflushed, drains unventilated, not intercepted from the sewer, running under the playground

with every joint leaking, and rendering the surrounding earth foul and stinking. This state of things had obtained for many years, and it so happens that these thirteen cases were the only cases of diphtheria notified among St. Barnabas scholars during the five years. I inoculated a number of culture tubes from the w.cs., drains, and surrounding foul earth, and carefully searched the growths for the diphtheria bacillus without finding any. Looking at the school premises alone, it seems possible that the infection of one or more of the w.cs. by the first case may have given rise to the rest; and if at the time that these cases occurred there had not been any other cases in the district in which the school children lived, this explanation might be considered a not improbable one. But there were other cases; and, moreover, four of these thirteen cases occurred in children belonging to the same family; four others occurred after the school had been closed, three within six days, a possible incubation period, but one 25 days after. One further case had not been to school for a month previous to its attack. The thirteen were all, except two, in different classes, and were distributed in five different rooms. Nine of the thirteen were in the infants' school, but divided between two different rooms, four in one, five in the other. Those in the same room might have interchanged pegs for their hats, cloaks, etc., and might have used the same towel and wash-basin. The slates and pencils are kept separate for each class, but not for each scholar, and are not disinfected. Six out of the thirteen children attacked died.

The first case was notified on September 20th, and was that of an infant of three—death took place the next day. After a clear interval of rather more than a fortnight, two more cases were notified on November 6th, and from this date the cases fell thus:—November 12th, 15th, 19th, 22nd, December 5th, two cases, brother and sister. The school was closed on December 13th, and the remaining four cases were notified on December 15th, 18th, 19th, and January 7th.

The floods to which I have already referred occurred at the beginning of November, and were in full evidence in the district in which these children lived on November 6th, the date on which the second and third cases were notified. As to whether the sewage contamination of these districts was directly responsible for these cases, or whether it acted by way of predisposing these children to contract the disease by personal infection in school or in the playground,

or in some other place, opinions will no doubt differ. The facts which, personally, I feel most disposed to bear in mind, are that this solitary instance of probable school influence in Bristol, over a period of five years, in the course of which no less than 101 schools had one or more cases of diphtheria amongst their scholars, occurred in a district which, with one exception, has the highest diphtheria rate, at a time of the year when diphtheria prevalence is generally at its highest, and, further, under circumstances which provided a possibly powerful predisposing factor. And this especially for the reason that these facts appear to bear upon what to me has always been a difficulty in crediting school influence with such a large share in causing that increased prevalence of the disease in many of our large towns of late years. If school influence, in so far as it depends upon increased opportunities of infection under favouring conditions of insufficient ventilation, is, as it appears to be within limits, a fairly constant factor for all large towns, it is difficult to understand why it should operate in apparently such different degrees in those towns. No doubt the schools in different towns differ in the amount of cubic space for each scholar, in the amount of "whipping up" that takes place, and in the precautions taken for preventing scholars who live in infected houses from attending school; and if these differences do exist to a sufficient extent to account for the different experience of schools in various towns, and if the two have been shown to vary together, the difficulty to a large extent disappears. But I am not aware that such association has been established.

Progressive increase of virulence would, perhaps, provide the mainspring which seems to be wanted to make the school influence factor sufficiently elastic: for the operation of this virulence factor, partly depending as it does on unrecognised conditions, might just meet the apparently haphazard way in which the large towns have been affected. But if I understand Mr. Shirley Murphy's diagrams in his report of 1893 to the London County Council, the school influence which stands out so strikingly in connection with the Autumn holidays, is by no means so easily recognisable for the other holidays. Seasonal prevalence at once suggests itself as being in some way connected with this difference in behaviour of school influence; but whether seasonal prevalence or progressive increase of virulence provides the mainspring to school influence, or whether both operate, there can be no question that the aggregation of children in the Public Elementary Schools provides very

favourable conditions for the spread of such a disease as diphtheria.

Given a certain amount of diphtheria prevalence in a district, it seems probable that the schools and the district generally would act and re-act on each other in such a way as to make it almost impossible to estimate the share belonging to each in determining the extent of the general prevalence. I am far from wishing to dogmatise on this subject, for this solitary instance of school influence in Bristol, if it be one, may possess no more value than belongs to single instances generally. My chief reason for mentioning it in such detail is a hope that I may have the benefit of hearing some remarks on this subject from those who have had more opportunities than myself of studying it.

Before returning to the subject of older and newer Bristol, I should like to give a very brief account of the way in which diphtheria has invaded streets and houses in the city generally.

The 501 cases were distributed in 437 houses, these again being divided between 331 streets, of which not more than sixty-three were invaded more than once during the five years. Of the total cases, 385, or close upon four-fifths, occurred singly in separate houses. The remaining 116 cases were distributed in fifty-two houses, and were grouped thus:—forty-two groups of two, eight groups of three, and two groups of four cases each. From a list of the addresses of the houses in district No. 6 which were invaded by diphtheria in 1893—the year of greatest prevalence—to each of which was affixed the date of the attack, it appears that out of a total of forty-five cases there were nine occasions on which two or more cases occurred sufficiently near each other in point of time to make it at all likely that they might be connected by way of personal infection. No evidence of such connection was found, in spite of careful inquiry, and opposite every one of these time-groups I have the note that the houses were widely—that is, by half-a-mile or more—or well separated, *i.e.*, not in the same street. One of these groups contained four cases, but these were all in different houses, and in two streets well separated. I select this district as an example, because it may be taken as representative of working-class Bristol, and because its diphtheria rate was one of the highest. It contributed 123 to the total of 501 cases for the whole city, and this diphtheria of a sort which killed close upon 50 per cent. of those attacked. The 123

cases in this district were distributed in 109 houses and seventy-eight streets. The corresponding total of ninety cases for the five years in district 9, another working-class district, were distributed amongst eighty-four houses and seventy-four streets.

Of the 385 cases which occurred singly in separate houses, only eleven were accounted for by a probable infection from a previous case, and in ten of these instances the previous case was not in Bristol. The list of the places in which the primary case occurred includes Ireland, S. Wales, London, Plymouth, Cardiff, Newport, Woollacombe, and four of the districts adjoining Bristol. Of the fifty-two groups of cases, in only one instance was the first case traced to a previous case of the same disease; this again being in one of the districts bordering upon Bristol. With the exceptions, therefore, where multiple cases occurred in the same house, it appears that diphtheria attacks in Bristol have rarely been definitely traced to an undoubted case of the same disease, in spite of careful inquiry.

The disease has invaded houses and streets in the most irregular and apparently haphazard manner. During the five years, never more than six cases occurred in one week, and this number only three times; two, three, and four cases a week being the usual numbers.

On the other hand, the occasions on which a week has passed without any cases being notified have been comparatively rare. With few exceptions, the houses invaded in any given week have been widely separated; as often as not in different districts, and when in the same district generally half-a-mile at least apart. Taking for a moment no account of the difference of incidence upon the central and suburban parts, imagine the bubbles irregularly rising in a pool of water to become fixed at the surface, and you have a fair picture of the manner in which diphtheria has appeared and become distributed in Bristol during the five years under consideration.

If the sewers of Bristol cannot be held responsible for its diphtheria experience: if school influence is equally unable to be connected with this—the complete absence of any established connection between the cases, except where multiple cases occurred in the same house, at once raises the question: What was the probable origin of the majority of the cases? It is difficult to imagine that none of them were connected by infection, though this was never demonstrated. As a possible indication that this was so to

some extent, at any rate, I find that if the districts are arranged in order of their diphtheria prevalence, and again in order according to the number of times on which disinfection was performed in each "to the medical attendant's satisfaction", the order is the same in both cases. With ten districts having diphtheria rates which vary considerably, this can hardly be a coincidence; still, it is quite possible that it is.

It may reasonably be urged, considering the nature of the disease, that as both children and adults may carry for months in their throats and nasal passages, without apparently feeling much the worse for it, virulent specific bacilli which can set up the disease in others, there remains no occasion for surprise at this failure to trace cases. And this may be so. What with cases of "fibrinous rhinitis" in children apparently in ordinary health, or at most having symptoms of a "slight cold", yielding pure cultures of the diphtheria bacillus, together with so far a small but increasing number of cases of "follicular tonsillitis", without a vestige of membrane and apparently of the ordinary kind, yielding the same bacillus to culture methods, this failure to trace cases need no longer be taken to discount the view that the multiplication of diphtheria cases is eminently and perhaps entirely due to personal infection. There can be little doubt that this failure to trace cases underlies, to a large extent, the disposition of not a few medical men to place to the account of sewer influence a large number of the cases of this disease.

My own experience, gathered from the bacteriological examination of some of the notified and suspected cases in Bristol, leads me to think that the number of the so-called latent cases is somewhat larger than has hitherto been recognised. The personal factor in diphtheria—I mean the degree of natural resistance—evidently varies enormously. In a report of the results of the bacteriological examination of some of the Bristol cases which has recently been published in *Public Health*, I have given an account of a case in which a boy of eleven, who could scarcely be called ill, presented a small patch of membrane on one of his tonsils. A culture tube inoculated from this yielded almost a pure growth of the diphtheria bacillus, which was subsequently employed for the preparation of antitoxic serum in the Pathological Laboratory, Cambridge, it having been found to be, on the whole, the most virulent specimen which up to that time had found its way into the laboratory. No need, then, to wonder that cases are not traced. But,

allowing for all this, there is another possible—indeed, I think, probable—origin of some of the Bristol cases, especially as this equally takes account of mild cases.

I have indicated on the map by means of dotted circles that Bristol, like other large towns, is surrounded by a certain amount of diphtheria; and have already stated that in eleven out of twelve instances in which an initial case was traced to a previous case, this latter was outside the municipal boundary: five out of the twelve being in the rural or semi-rural districts surrounding the city, the remainder in various parts of England, Wales, and Ireland. Every one of the five districts bordering on Bristol contains areas of houses which merge insensibly into the houses and streets of Bristol; every one of the same has a higher diphtheria rate than that of Bristol; and not one of them possesses a disinfecting apparatus.

There cannot be a doubt, I think, that some considerable but uncertain number of cases in Bristol are either the result or the cause of cases outside its boundaries; and it seems only reasonable to assume that, on the whole, the balance of result remains with Bristol. Speaking generally, the organised means of dealing with infectious disease in the outside districts will not bear comparison with those of Bristol. They adopted the Notification Act at different times—1890, 1891, two in 1892, and one in 1894; but with the necessary reservation for incomplete figures over a short space of time, a comparison of the diphtheria incidence rates of these districts with that of Bristol shows that they vary together in a somewhat striking manner. For instance, the notification returns for 1894, the first year of notification work in the Stapleton Local Board District to the north of Bristol, a district which has a common boundary with the inside districts 8 and 9, included twenty-three cases of diphtheria and membranous croup; and the rate of 1.4 per 1,000 of its population, corresponding to this number, is considerably higher than any of the Bristol rates. This was the year in which one of these two inside districts had its greatest number of cases, and the other a number only one short of its greatest.

Again, in the Local Board District of St. George (Table III), with a population in 1891 of 36,718, adjoining Bristol on its eastern side, the cases rose from eight in 1891 to twenty-four in 1892, the year in which the Bristol cases increased so markedly, and particularly the year in which district 9, a district whose streets are continuous with

those of the St. George's district, showed such a marked increase in its number of cases.

It is, however, from the Long Ashton rural district, to the south of Bristol, that unmistakable indications of concomitant variation come. It has already been pointed out that Table III affords a strong indication that the 1892 increase of cases in Bristol was due almost entirely to an increase in districts Nos. 9 and 6, particularly the latter, a district which runs by insensible degrees into this rural district of Long Ashton. The same table shows that the further increase in Bristol in 1893 was associated with increase in the same districts, again particularly with No. 6. Looking now at the annual number of cases of diphtheria notified in the Long Ashton rural district, it appears at once that these varied closely with those of district No. 6, and with those of Bristol as a whole. A reference to the foot of Table III shows that the ten cases in 1891 became sixteen in 1892, and as many as forty-eight in 1893, the year of greatest prevalence in Bristol. These forty-eight cases answer to a rate of close upon two per 1,000 of the population, about 26,000, of the Long Ashton district. It can scarcely be a coincidence that these Long Ashton figures vary so closely with those of district No. 6, considering the topographical and vital connection between the two. The association between the two sets of figures, moreover, is not merely one of variation. The actual amount of diphtheria in the Long Ashton rural district is such as might well prove an important source of diphtheria supply to Bristol.

Of the forty-eight cases in 1893 in this district, no less than twenty-four occurred in a certain part of it adjoining Bristol, where the Wells road runs into the city from the S.E., giving a rate of 2.4 per 1,000 upon its calculated population of 10,000. No less than fifteen of the remainder of these forty-eight cases occurred in the village of Yatton, about ten miles down the Great Western main line, giving a rate of 8 per 1,000 upon its population of 1,870 in that year. A similar rate in Bristol for the same year would have resulted in close upon 2,000 cases, instead of the 138 which actually occurred. Not a few persons engaged in business in Bristol during the daytime reside in this village, and no insignificant portion of the Bristol meat supply comes from the monthly cattle fair in the same place. The figures, so far as I have been able to gather them, for the other outside districts, tell the same tale, though not so plainly.

If it be true, then, that some uncertain but perhaps considerable number of the Bristol cases owe their origin to infection from cases in outside districts, that the rates outside and inside the municipal boundary vary together, and that the daily and hourly comings and goings between the two by way of business transactions, social intercourse, and other more irregular means, provide an adequate cause for all this, it would appear at first sight to be very difficult to explain in the same way a difference of incidence on two still more closely related areas within the same municipal boundary. But part of the difficulty lies in the manner of stating the problem. Forget the present municipal boundary, and consider the case as one of contrast between an old, densely-packed area, the old city of Bristol, and a surrounding area more sparsely populated, some of which is entirely rural, some semi-rural, and the remainder newly urban; and then, I think, it clearly appears that within the area of Greater Bristol, an area very largely covered by houses, and which may be roughly taken as a circle of not more than five to six miles in diameter, we get a further instance of that difference of diphtheria incidence upon dense and sparse districts—a peculiarity insisted upon by Dr. Thursfield in 1878, and subsequently clothed in such a wealth of statistics by Dr. Longstaff.

It might, perhaps, have been expected from the way in which the subject developed in Dr. Longstaff's hands (see Appendix), showing, as he did, that, judging from death rates, an inequality of diphtheria incidence exhibited by large registration divisions differing in density of population, was still indicated by a comparison of the component counties of these divisions, and was by no means lost sight of in a similar comparison of the component districts of these counties; it might have been expected that such a contrast would bear still a little more development, though perhaps, not quite to the extent of showing a difference within the limits of a single large town. But I think there can be no mistake on this point. Dr. Longstaff's results, based on death rates, and taking account of the whole of England and Wales, stand the test of 'notification' not only within the area of Greater Bristol, but within the city's present municipal boundary.

It would appear, then, that newer Bristol has a higher diphtheria rate than the older part, not because it is newer, but because of its position as regards the outside districts; that its rate is intermediate between that of older Bristol

and that of these districts generally, because it occupies an intermediate position between these parts.

Convinced as I am that this is the real explanation, or rather the true way of looking at the distribution of diphtheria in Bristol, it becomes a matter of equal interest and importance to attempt to gain some insight into that method of operation of some law of diphtheria distribution which can result in a difference of incidence on two such closely and vitally connected areas as Central and Suburban Bristol, for this should have been the title of my paper.

That in such a matter as the distribution of a communicable disease, so fine a gradation between one part and another of a large town should be manifested, considering the intimate relation between the several parts, leads necessarily to the reflection that some law of the spread of diphtheria by infection, like economic laws, "grinds exceeding small". And this reflection is not a little strengthened by a consideration of the facts that so large a proportion of the total attacks fall upon children, whose daily life revolves in a comparatively narrow circle; and that probably the virus of the disease is not air borne to any great extent, infection depending rather upon direct transference of bacilli along with fresh toxic products, from mouth to mouth, or mediately by contaminated hands, food, drinking vessels, and other articles which are apt to find their way to the mouth.

There is another feature of newer Bristol which can hardly have escaped playing a part in diphtheria distribution. Bristol, like other large towns, has received its share of the ruined farmers, unemployed agricultural labourers, and small country shopkeepers, who have sought amongst the rapidly multiplying population in the outskirts of a large town, opportunities of making a living.

This migration, which reached its acute stage between 1876 and 1880, the period of the establishment of American competition as a permanent and dominating factor in our food supply—a migration which is still going on—has brought about a closer relation between certain parts of large towns and rural districts in several ways, but particularly from the present point of view, in that a considerable number of these immigrants have left relatives behind them, and the occasional visiting between the members of families rendered so easy by the astonishingly low fares of the railway companies for excursion tickets, may well have played, and still be playing, some perhaps

not inconsiderable part in the urban increase of diphtheria. It may not be out of place here to note that the depression of agriculture which has caused this movement of population has fallen most heavily upon the strong clay lands which are so expensive to work, and the connection between clay formation and damp, and between damp and diphtheria, needs no emphasis here.

The wonderful development of the railway system in England, and particularly the addition of third-class carriages to every train in the early part of the decade, 1870-80, materially assisted and even encouraged the movement referred to. "On the 1st of April 1872, the second-class railway carriages on all the Midland lines . . . . . were withdrawn, and third-class carriages were added to all the trains on the system",* with the result that, during the first three months affected by the change, no less a net increase than close upon a million passengers were carried. On the Great Western Railway system, during the last six months of the same year, a similar though not so extensive a change of policy was followed by a net increase of close upon three million passengers.

The nature of the geological formation, and the configuration of the surface in Bristol, aided by even such imperfect building bye-laws as have obtained until within quite recent years, have prevented the powerful factor of dampness of dwellings from playing any appreciable part in its diphtheria incidence; but a fairly extensive acquaintance with the rural districts surrounding Bristol strongly inclines me to agree with the general conviction that of all the influences, apart from personal infection, which have to be taken into account in trying to understand the distribution of diphtheria, the powerful predisposing factor of damp can least be neglected.

An intimate knowledge of the courts and alleys of Bristol, particularly those in the heart of the city, as the result of about ten years' work amongst the poorer classes, enables me to state that there is nothing in Bristol in the way of dilapidated and unwholesome dwellings which can be compared for a moment with what may be found a few miles out of Bristol even nowadays—houses with roofs which provide for a certain amount of ventilation, but which afford little protection from rain, and with walls streaming with damp, and so frail, that a fairly strong man could almost push his foot through any part of them. I

* *The Annals of Bristol in the Nineteenth Century*, by John Latimer. Bristol: W. and F. Morgan, 1887.

went over every room in every house in a long row of such—they can only stand up in rows—only last year. Whatever may be the case with other towns, the courts of old Bristol were built in days when houses had real walls, and roofs of a character which even now a little occasional repair enables to thoroughly protect the walls and their inmates from damp.

Whether diphtheria was introduced into England afresh about the year 1855 or not, given a certain amount of the disease in the country, the excessive prevalence of the disease in rural districts during the third quarter of the century irresistibly connects itself in my mind with that terrible picture of agricultural labourers' tenements given in 1845 by the then Mr. Disraeli, in his novel of *Sybil, or The Two Nations;* with reference to which the author says in his preface, that he found the absolute necessity of suppressing much that was genuine; giving as a reason that the air of improbability which the whole truth would inevitably throw over his pages might deter some from their perusal.*

I recently asked Dr. Adams, now for many years the Medical Officer of Health for the Long Ashton Rural District, where he would take me in his district if he wished to show me a few typical places for diphtheria prevalence. His answer amounted to this: that he might show me by the way many houses, whose overflowing cesspools would offer themselves as an explanation for the diphtheria of their inmates; but he would be going to certain areas where the clay comes to the surface, in order to point out houses where the patch of garden attached would lie under water for days after a moderate rainfall. He would not forget to take me to the village of Yatton, which I have already mentioned, where the surface of the ground is below the level of the adjacent Severn at high water.

If I were obliged to give a reason for much of the urban increase of diphtheria in England during the last twenty years or so, I should be strongly inclined to point to those movements of population due to agricultural depression, and secondly to the greatly increased and still increasing volume of the stream of communication between town and country which has taken place in connection with the

* For still stronger language and further details on the same subject, see Simon's *Public Health Reports*, vol. ii, p. 108, *et seq.* London: J. and A. Churchill, 1887. To the evil influence of dilapidated, damp, and generally unwholesome dwellings was added that of excessive overcrowding.

development of the railway system; especially looking in this connection to the influence of exhibitions, shows, annual outings of the workers in large factories, and the hundred other instances of a full appreciation of the means of travelling about the country.

If I were finally asked to give a probable reason why diphtheria is increasing in some large towns and diminishing in others, it would seem to me worth while to endeavour to find out what was going on in the rural districts adjoining them.

There is one town in England which might be expected, on the assumption that all diphtheria is the result of personal infection, to provide an exception to this. Considering the enormous stream of people which pours daily into London, it seems likelier than not that the metropolis would lay the whole of England under contribution for its share of such a disease as diphtheria; and, as a matter of fact, it is pointed out by Dr. Thorne Thorne, in his work on diphtheria, when comparing the London rates with those of England and Wales, that "In London the oscillations in the rates have been somewhat similar to those for England as a whole"; and that, taking the period 1881-89, "the increase which has been taking place in the country generally during the latter part of that period is found to be notably parallel to the excess occurring in the metropolis."

I had not the slightest conception, when commencing to put together the materials for this paper, that the comparatively small amount of diphtheria in Bristol would lead me into any flights of theory, or to take notice of London in perhaps so unceremonious a fashion; and I cannot even hope to have escaped some of the many pitfalls and fallacies with which this difficult subject bristles.

If I have made my figures bear too heavy a burden, and put too great a strain upon a single thread, my excuse lies in the fact that a close connection with diphtheria work in Bristol for some time past has engendered a feeling that it is the duty of everybody who has the opportunity of studying such a terrible disease, to endeavour to contribute even a mite to the solution of that very pressing problem, its greatly increased prevalence in some of our large towns.

APPENDIX.

Dr. Longstaff, in his paper on "The Geographical Distribution of Diphtheria in England and Wales,"* dealt with the mortality statistics from registered diphtheria, and advanced to his final point by taking up the following positions:

1. As regards "registration divisions .... large areas, and most of them comprising several counties," .... "rural life is not unfavourable to fatal diphtheria; while, on the other hand, the disease shows no special proclivity for densely populated districts."

2. As regards the component counties of these divisions, the same fact is indicated. "..... we may safely say that density of population is not a factor of prime importance to the production of fatal diphtheria."

3. Looking at the component districts, dense, medium, and sparse, of these counties, again the same indication appears. "It can scarcely be denied .... that very many of the largest towns of the country have suffered comparatively little from diphtheria." "..... this disease has a strong predilection for scattered rural populations, and even for districts reputed to be exceptionally healthy."

A comparison of the diphtheria death rates in dense, medium, and sparse districts of England and Wales yielded the figures in the following table:

No. of Deaths from Diphtheria per Million Persons living at all Ages in England and Wales.

Periods.	Dense Districts.	Medium Districts.	Sparse Districts.
1855-60	123	182	249
1861-70	163	164	243
1871-80	114	125	135

Dr. Longstaff's interpretation of his figures is that "..... in each succeeding decade the towns .... have, relatively to the rural districts, suffered more and more."

A consideration of the same figures leads Dr. Thorne Thorne to express himself thus: "..... during each successive period, fatal diphtheria, which, though always maintaining a predilection for sparsely populated rural areas, came more and more to hold its own in densely peopled urban areas."†

Both these readings are, of course, legitimate; but, from my own point of view, instead of a relative, I prefer the following direct interpretation. A period of time, 1855-80, which was marked by a notable decline of diphtheria mortality in sparse districts, also witnessed a very decided, though not so marked, decline in medium districts. During the same period, on the whole, the mortality in dense districts also fell, though to a much less extent. This fall for the whole period in the dense districts was interrupted by a marked

* *Studies in Statistics*, 1891.

Diphtheria: its Natural History and Prevention, 1891, p. 8.

rise during the middle decade of the period, 1861-70, a rise which was associated with the equalisation of the mortality in dense and medium districts, and this at a time when the contrast between the rate for the sparse districts and that for the rest of the country was still very striking.

I believe it is a fact that the development of facilities of communication, especially with regard to railways, proceeds chiefly—there are exceptions—by first connecting together centres of population, and only finally, where this has not been achieved as a bye-result of the first step, by opening up sparse districts. If this be so, it would be expected that the distribution of a communicable disease which has its main stronghold in rural districts, would, as a result of such increased facilities, first display a tendency to equalisation in the more densely populated parts.

Dr. Longstaff takes up this point of facility of communication as a possible explanation of the relative increase of diphtheria in towns, only to lay it down again for this reason: ". . . . facility of communication, or the reverse, cannot be the true explanation . . . . since other communicable diseases, such as measles, scarlatina, and whooping-cough are most fatal in towns." If I follow Dr. Longstaff here, it is the analogy implied in the term 'communicable' which furnishes his suppressed major premise, viz, the law of the spread of measles, scarlatina, and whooping-cough, by infection, is the same as that for diphtheria. But can this be maintained? Do we not know enough of the behaviour of these several diseases to say that very probably each spreads according to a law peculiar to itself? Diphtheria certainly presents many peculiarities in its natural history, of a sort which would materially influence its manner and extent of distribution.

In another place, Dr. Longstaff says: "To check these results" [the positions 1, 2, 3 set forth above] "and with a view to partially eliminating the effects of communication of the disease by infection, I have prepared Table XIV, in which are given the registration districts whose diphtheria mortality has always exceeded that of the county in which they are situated; also Table XV in like manner, *mutatis mutandis*, for districts of low mortality." If I apprehend Dr. Longstaff's meaning, the idea is that districts in the same county would not be likely to exhibit, over any considerable period of time, a marked contrast in respect of the fatality of one and the same communicable disease. Here again the whole position is involved in a similar rendering of the expression "communication by infection". Moreover, it is possible that a permanently acting though diminishing cause may have been associated with some peculiarity of rural districts. Such a cause, predominating in these districts at the commencement of the period under review, would, I think, be found in the condition of the agricultural labourers' tenements, and the serious overcrowding which took place in them. The gradual betterment of these which has taken place would tend to remove that powerful predisposing cause of diphtheria, dampness of dwelling; and might thus have been associated with the steady decline of diphtheria mortality in rural districts, while increased facility of communication would accelerate the rate at which equalisation has been taking place.

EXPERIENCES IN RELATION TO CHOLERA IN INDIA FROM 1842 TO 1879.

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(*Read: January 17th*, 1896.)

SYLLABUS.

Introductory.
1. Symptoms of Cholera.
2. Sporadic Cholera.
3. Epidemic Cholera.
4. In Relation to Age.
5. In Relation to Sex.
6. The Development of Epidemics.
7. Diffusion of Cholera.
8. In Relation to Rivers.
9. Potable Water.
10. In Relation to "Poison" and "Germs".
11. Atmospheric Conditions.
12. Prevailing Winds and Storms.
13. In Relation to Season.
14. In Relation to Natives and Foreigners.
15. In Relation to certain other Diseases.
16. In Relation to Animal Life.
17. Whether Contagious and Infectious.
18. In Relation to Troops in Motion.
19. In Relation to Conservancy.
20. Quarantine by Land.
21. Encamping Troops.
22. Precautionary Measures.
23. Inoculation against Cholera.
24. Treatment.
25. Summary.
Conclusion.

Introductory.—The plan in accordance with which the following remarks have been arranged is this: In the first place, to consider the phenomena of cholera presented

in the individual subject of that malady; in the second, those of an epidemic as a whole; in the third, some points relating to the incidence of particular outbreaks in regiments or other considerable bodies of British troops in India; in the fourth, some measures intended to be precautionary against its occurrence; and lastly, the therapeutic method which seemed most appropriate in dealing with individual cases. But with due consideration for time at our disposal, it becomes necessary to limit the number of points selected for comment, and also that the comments on each be brief, and in a sense fragmentary. The period to which the remarks refer is that from the beginning of 1842 to the end of 1879.

1. *Symptoms or Phenomena.*—Familiar as they are to those of us who have had considerable length of service in India, they are now recapitulated, with the objective view of enabling us the more definitely to realise the precise conditions with which we are about to deal.

Those which are characteristic of cholera are the following: Profuse vomiting and purging, the evacuations like rice water, painful spasms affecting the abdominal muscles and those of the extremities; suppression of urine nearly or altogether complete; the aspect of the patient once seen can never be mistaken, though difficult to describe in words; the sunken bloodshot eye, surrounded by a bluish zone; contracted features, the expression that of despair; restlessness of body; carelessness as to desire for life; intense thirst, the desire being for cold drinks to quench what is expressed by the sufferer as "burning heat" within, while to the hand the surface feels clammy and cold, the tongue and breath also cold. The voice has the distinctive "hollow" tone, little above a whisper, as characteristic in its way as are the indications enumerated; the fingers are corrugated, the entire surface livid, the pulse, at first rapid and small, becomes imperceptible, vomiting and alvine evacuations cease, the limbs are unmoved, vitality rapidly ebbs, and the patient appears literally to fall asleep in death.

The asphyxiated form of the malady was comparatively rarely met with during the period to which these notes refer.

2. *Sporadic Cholera.*—The characters so enumerated distinguish cholera, whether occurring in isolated cases or as an epidemic. On many occasions the former is preliminary to the latter. In 1861, it was so at various stations in Northern India, notably in respect to the 88th

Regiment at Moradabad, and the 42nd at Agra. In 1874, a similar circumstance was recorded. In that year isolated or sporadic cases occurred as nearly as possible simultaneously at stations far apart, namely, Fort William, Lucknow, Thyetmyo, Poonah, Dinapore, and Ferozepore. Whereas in Northern India such cases have their seasonal and irregularly periodic occurrence, in the Gangetic delta they happen at all periods of the year, generally in the absence of apparent cause, but on occasions after errors in respect to food or beverages, and at times as result of saline drastic or depressant medicines. Nor is the occurrence of idiopathic sporadic cases on all occasions followed by an epidemic outbreak, though for the most part it is so.

3. *Epidemic Cholera.*—The simultaneous occurrence of cholera epidemics at places in India far apart from each other has been often noticed and recorded. During the prevalence of a particular epidemic, the degree of its severity has varied at different places within its general area; in 1861 it raged with peculiar intensity at Gwalior, Agra, and Meean Meer, while in Rohilcund it was comparatively mild in type. Neither is the severity of successive epidemics in the same locality alike, although all apparent physical conditions remain unaltered. Thus, in 1841, the district to the west of Cawnpore was very severely affected; whereas in 1842 the type in the same locality was mild. In 1875, certain villages in Central India that had suffered severely on a recent previous occasion remained exempt, while others within the same area were affected; yet, in 1876, those that had then escaped were affected. In Northern India the epidemic of 1852 was comparatively mild; that of 1876 comparatively severe within the same area.

As in the case of yellow fever in the West Indies, so with cholera in India: the occurrence of epidemics is periodic, the apparent conditions of particular localities affected remaining unaltered meanwhile. The duration of intervals between such epidemics extends on certain occasions to several years, and in this sense is more or less defined.

The incidence of particular epidemics is variable; the disease not unfrequently attacks soldiers of the same regiment and spares those of another, or all those located at the same stations, the circumstances and conditions of all being apparently identical. It has on occasions left soldiers exempt, while it attacked their wives and children; in others it has affected the men, leaving their wives and

children exempt—as happened notably in the epidemic of 1867. The occupants of a particular barrack-room may suffer, while those in adjoining apartments escape, as happened in Fort St. George, Madras, in 1870.

4. *Age.*—Statistics relating to the year 1872 record that of 118 children who died by the epidemic in that period only one was under four months of age; that the disease was comparatively rare during the two first years of life; but that the ratio of mortality to attacks was greatest in those of from two to three years old. According to a series of statistics extending over five years,* all ages suffer alike, from that of twenty to thirty and upwards—that constituting the period of a soldier's active life in India. Statistics relating to the intermediate ages are unavailable.

5. *Sex.*—According to general statistics the rate of attack among soldiers in India is 17.40 per 1000 strength; of deaths 7, as against 15.80 and 5 respectively among soldiers' wives. In the epidemic of 1869 the ratio of attacks to strength was 25.7; 26.1 among their wives and children; but, unfortunately, particulars are wanting with respect to the incidence of the malady in each of the two classes so included. On some occasions, so severe has been its rate of incidence among women in India, that there are observers who believe that in the mass their liability to attack is proportionally greater than that of men. But, as shown above, the results of observations relating to this point differed among themselves, and in different epidemics.

6. *Development of Epidemics.*—In 1845, epidemic cholera suddenly occurred in the month of June at Cawnpore; it raged with intense violence during four days, and then ceased with equal suddenness as it had appeared. In 1846, at Kurrachee and some other places, the epidemic outbreak was preceded by cases of diarrhœa and of sporadic cholera. In 1861, the epidemic which prevailed in northern India presented various modes of development in different places. In some it appeared suddenly; in others it was preceded, during variable periods, by diarrhœa and malaise. In some instances, isolated cases of cholera occurred in different parts of a cantonment distant from each other. On occasions, the malady, after prevailing violently for a few days, relaxed in intensity only to recur with increased virulence. In certain instances, communication with in-

* Recorded in *Hygiene of Cholera*, p. 57.

fected localities could be traced. In others simultaneous outbreaks occurred at places far apart, and in the absence of seemingly possible communication between persons, or with other infected places.

In 1867, cholera appeared simultaneously at Hurdwar and Bijnore, separated from each other by the river Ganges; also at various places far apart, the intervening districts remaining unaffected. In 1869, the epidemic suddenly appeared in Rajpootana, occurring simultaneously at places 300 miles apart. In 1871, the epidemic suddenly and with great intensity occurred in the 18th Hussars at Secunderabad, affecting that regiment alone among the large force there stationed. In 1876, it affected the portions of the Chittagong district that had been inundated by the cyclone of that year.

7. *Diffusion of Cholera.*—On various occasions, notably in 1871, cholera has been restricted within definite limits, notwithstanding that free communication took place between the district affected and those around it. On the other hand, instances are numerous in India, as elsewhere, of an epidemic spreading far and wide; others, in which an epidemic of one period having affected a locality to which a previous outbreak had been restricted, has on the second occasion spread beyond the limits of that district. An occurrence of this kind was recorded in relation to the cholera outbreak of 1827, as compared with those of 1826 and 1825, namely, seventeen years prior to the earliest date properly included in these remarks, but noteworthy with reference to the present analysis.

In the year 1842, cholera prevailed in Lower Bengal, but did not extend northward beyond Cawnpore. [Here the circumstance may be noted parenthetically that, in 1817, the disease in epidemic form extended to Jessore from without, it having, in the first instance, occurred among the troops engaged in military operations in Bundelkhund.] In 1843, it prevailed with great intensity at Agra. During the period from 1840 to 1843, both inclusive, an epidemic current extended gradually down along the course of the Irawaddy to Rangoon, and thence to Moulmein. In 1844, a current of epidemic progressed from the Punjab south-eastward to Delhi, Bengal proper being free except as regards a few localities. In 1845, it extended south-east to Jhelum, Loodianah, Umballah and Meerut, from Peshawur; south-west to Hyderabad, Scinde. In 1846, it prevailed all over the Bombay Presidency; in 1848, at Dacca, Calcutta, Dinapore and Cawnpore, but did not

GEOGRAPHICAL POSITIONS OF PLACES NAMED.

STATIONS.	LAT. N.		LONG. E.	
	Deg.	Min.	Deg.	Min.
Agra	27	10	78	5
Allahabad	24	47	81	11
Almorah	29	35	79	41
Bijnore	29	22	78	10
Bellary	15	8	76	57
Bhaugulpore	24	32	86	21
Bombay	18	55	75	53
Calcutta	22	34	83	23
Cawnpore	26	28	80	23
Chittagong	22	21	91	52
Comorin, Cape	8	4	77	35
Cudderpah	14	0	78	0
Curnool	14	54	77	46
Daccan	23	43	90	26
Darjeeling	27	2	88	18
Delhi	28	33	77	16
Dinapore	25	38	85	5
Ferosepore	30	56	74	38
Ganjam	19	22	85	2
Ghooty	15	6	77	41
Gondak	27	7	82	0
Gwalior	26	13	78	12
Hasarabagh	23	59	85	24
Hurdwar	29	57	78	12
Hyderabad, Scinde ...	25	23	68	24
Jhelum	32	55	73	46
Jounpore	25	41	82	43
Jubbulpore	23	11	79	59
Kurrachee	24	51	67	4
Lahore	31	34	74	21
Loodianah	30	55	75	53
Lucknow	26	51	80	58
Madras	13	4	80	17
Meean Meer	31	30	74	25
Meerut	29	0	77	45
Mooltan	30	11	71	28
Moulmein	12	35	97	58
Moradabad	28	49	78	49
Monghyr	25	22	86	30
Nursingpore	22	56	79	14
Nynee Tal	29	22	79	29
Poonah	17	54	73	24
Pooree	19	48	85	51
Rangoon	16	55	76	25
Rohilcund (see Moradabad) ...	28	49	78	49
Salem	11	39	78	11
Saugor	23	49	78	43
Secunderabad	17	26	78	33
Shahjehanpore	26	50	83	53
Simla	31	6	77	11
Thyet Myo	17	35	96	32
Umballah	30	21	76	52
William, Fort, Calcutta ...	22	34	83	23

extend northward beyond Agra. In 1849, Behar and Central India suffered, the epidemic reaching Bombay from

the eastward. In 1851, in the south-western parts of Bengal, in the Madras and Bombay Presidencies, and along the western coast. In 1852, over the North-Western Provinces and Punjab, extending to the mountain stations of Almorah and Simla. In 1853, in Dacca and Assam, extending to, but not beyond, Cawnpore. In 1854, in Bengal proper, and in that province only. In 1856, simultaneously at several places around Agra, extending thence to Gwalior in the south, and to Nynee Tal in the north. In 1857, with great violence among the troops besieging Delhi, more especially in the 75th regiment.* In 1859, in Lower Bengal, and to, but not beyond, Cawnpore in that direction; also at Bombay, and along the western coast from Kurrachee to Cape Comorin. In 1860, in Bengal, Oude, and Bombay; also in Assam, and thence to Darjeeling. On the same occasion it prevailed with great intensity at Agra.

In 1861, the great epidemic of that year in one region extended along the Grand Trunk Road. It thence branched off, passed over several villages, and attacked others more distant. In some portions of a district it prevailed with great virulence; in others, with less intensity; and villages occasionally escaped attack in the absence of apparent conditions to account for the circumstance. In Rajpootana the epidemic suddenly appeared in the Bhurtpore district; thence it spread in a north-west direction; it also extended south-west to a particular point, where it suddenly ceased. It did not attack the British troops in the Fort of Lahore until three weeks after it had become prevalent among those at Meean Mear, nor could any communication be traced as having taken place between those in the two localities. In Northern India generally, that particular epidemic seemed to be diffused independently of all discoverable conditions.

Official reports with reference to that epidemic in northern India record that it crossed and moved directly contrary to currents of rivers and of wind; that when the wind blew in directions favourable to the course of aerial miasmata, the epidemic did not appear to advance with any particular velocity.

In 1863, cholera prevailed along the valley of the Ganges, extending to Hazarabagh on the one hand, to

* The 75th had been rapidly brought from the hill station of Kussowlie to take its part in actions against the mutinous Sepoys. Other regiments, whose service had been long and continuous at stations in the plains, either escaped cholera, or suffered to a comparatively small extent during the campaign of the Mutiny.

Oude on the other. It prevailed in Bombay also, having been conveyed, as believed, by pilgrims. In 1864, all over Bengal, central and western India, including Bombay. In 1865, along the Malabar coast, in Mysore and Bellary, in Bombay and Scinde. In 1866, in the west of India, Punjab, Cashmere, and Afghanistan; also in Bengal proper. In 1867 it continued to prevail in the Punjab, Cashmere, and Afghanistan. In 1869, in Central India. In 1874-5 the epidemic was unusually diffused over India, the mortality greater in the latter than in the former year.

8. *In Relation to Rivers.*—River deltas in which cholera is endemic, and occasionally epidemic, differ among themselves in respect to geology, the nature and quantity of impurities deposited, the range of temperature and extent of rainfall along their courses; as, for example, those of the Brahmaputra, Ganges, Godavery, Cauvery, Nerbudda, and Indus; so in respect to the course of those rivers and of their respective tributaries. Yet, according to statistics, of 152 outbreaks of cholera in the Madras Presidency, 106 have occurred in places adjoining rivers.

In 1842, and subsequently, troops ascending the Ganges in country boats were suddenly attacked while the boats were moored for the night at particular places, the disease not persisting on their proceeding therefrom. Of such localities, one was near Bhaugulpore, a second near Monghyr, and a third opposite Dinapore. On occasions cholera prevailed along both sides of a river; thus, in 1861 it affected the natives on both sides of the Jumna, near Allahabad; in 1876, on both sides of the rivers in the Narsingpore district of the Central Provinces.

In some instances, the progress of an epidemic has been downwards along a river course; as, for example, in 1842, when cholera so followed the flow of the Irawady from the north; in 1845, from Peshawur, an epidemic current descended by the valley of the Indus, and so reached Kurrachee. In other instances, the progress of an epidemic has been upwards, as against the current of a river; thus, in 1862, cholera having occurred at Taku, extended thence upwards against the Peiho, and so reached Peking. A river has acted as if it were a barrier against the further progress of an epidemic; in 1862, in Rajputana, the course of cholera seemed to be so turned by the rivers Bunass and Chumbul.

9. *Potable Water and Cholera.*—The principle was generally accepted, and acted upon, that a connection existed between the use of contaminated water and the occurrence

of cholera, whether in individuals or communities. But observations made over extensive tracts of country, comprising numerous military stations, presented differences among themselves in respect to the degree to which that connection has existed, or existing has been traced. For example, in 1861, at Calcutta, of nineteen persons who drank water subsequently ascertained to have been contaminated by recent cholera dejecta, five became affected with that disease within three days, while fourteen remained unaffected.

In 1867, cholera spread in several gaols in Bengal, the drinking water of which was declared free from contamination; the epidemic appeared in places where, although the natives drank contaminated water, they had drank the same water continuously during the preceding twenty-three years, but remained the while exempt from the disease. At Peshawur, in 1869, the native troops used water contaminated with fæcal matter, and escaped; the 104th Regiment obtained its supply from a well declared pure, yet the soldiers belonging to it suffered severely. In 1871, at Secunderabad, cholera became epidemic in the 18th Hussars; while it was so, the soldiers were using the same water supply they had previously employed without evil result. During the prevalence of the epidemic in that regiment, other troops used the same water supply, yet remained unaffected by the disease. In 1872, a similar circumstance occurred at the same station; of various bodies of troops using the same water supply, some suffered from cholera, some did not. Other instances could be given did space permit.

Throughout the long period referred to in these notes, various methods have been applied to potable water with the assigned object of counteracting contamination by choleraic poison. The subject has been much dwelt upon by both army and civil medical officers in India, and by commissions, international and others, the general results being that they doubt if boiling, or filtration, or both combined, are sufficient to counteract contamination with that "poison".

Various methods of purifying water for barrack use have been used in India; among them the native plan by means of *strychnos potatorum*, lime, sand and gravel, charcoal and sand, magnetic oxide of iron and sand, filtration by means of double casks, according to the method of Dr. Lind and others.

10. *In Relation to "Poison" and "Germs".*—In India,

during the period now referred to, chemical and microscopical investigations relative to cholera were actively conducted, more especially in the concluding decade of it. So far the results of those investigations were declared to be negative in respect to the former; while with reference to the latter they were expressed after this manner: No special fungus has been detected in choleraic matters which had not also appeared in other media; there is no specific germ to be found in the atmosphere of localities where cholera prevails that can be connected with the production of cholera. The nature of the generating principle of cholera has evaded all investigation; it is only known by its effects; the presence of a cholera poison has been assumed; the disease is only known to us as a phenomenon; there is not a jot of evidence to prove that there is a causative entity which gives rise to the phenomena—such was the conclusion arrived as a result of observation and inquiry up to the end of the year 1879.*

11. *Relation to Atmospheric Conditions.*—In 1843, at Agra, the month of June was characterised by unusually severe thunderstorms and heavy rains; in July cholera of virulent type occurred in the 39th Foot, and continued onwards through the greater part of August. In 1845, at Umballa, the seasonal rains suddenly ceased, the sky became clear, the sun bright: simultaneously with the change cholera occurred. In the same year, at Madras, the epidemic of cholera was attended by a hot land wind by day, with heavy rainfall in the evening. In 1846, at Kurrachee, the violent epidemic in the 78th Regiment was attended by a moist and stagnant state of the atmosphere. In 1848, during the prevalence of a similar epidemic in the upper provinces of Bengal, there was a seasonal deficiency of rain. In 1854 the epidemic was attended by low barometric pressure and temperature, with rain and constant movement of the atmosphere. Similar differences characterised subsequent years.

12. *In Relation to Prevailing Winds and Storms.*—In 1849 cholera reached Bombay from the eastward, the south-west monsoon at the time prevailing in full force. The epidemic of 1856 appeared to be unaffected by the

* *Germs.*—Their presence bears the same causative relation to cholera as infusoria and other minute organisms which exist in myriads in the muddy waters around and beyond Saugor Island bear to the storm wave which, under the influence of the cyclone, sweeps over and devastates huge tracts of Lower Bengal; or which the motes that similarly exist in the clear still atmosphere bear to the destructive hurricane.

direction of the prevailing wind. In July, 1860, at Ganjam, cholera advanced against the south-west monsoon. In 1865, in Bengal, it advanced against the same monsoon. In 1869-70 it traversed the Madras Presidency in opposition to the prevailing wind. In 1873, at Thyet Myo, the 45th Regiment was severely affected at the same time that the occupants of the native town and gaol, both situated to windward, were exempt; as were also the Royal Artillery and their followers, all of whom were situated to leeward of the 45th. In 1869 epidemic cholera in the gaol at Jounpore suddenly ceased on the occurrence at that place of a storm in the month of August. In 1871, at Secunderabad, the occurrence of a dust storm heralded the disappearance of the epidemic from the 18th Hussars. But in 1845, at Meerut, cholera of very virulent type attacked the 10th Foot immediately after the occurrence of a hurricane, an officer, and the wife of an officer, being its two first victims. In 1846 a similar occurrence happened to the 88th Regiment at Kurrachee. In 1861 at Meerut; in 1867, at Meerut, Peshawur, and Hurdwar. But in 1872 instances occurred in which the outbreak of cholera was neither preceded by atmospheric storms nor other perturbation.

13. *In Relation to Season.*—In 1842, cholera occurred in Bengal in April, and continued throughout the remainder of the year. In 1843, at Agra, in July and August. In 1844, at Peshawur, in November. In 1849, at Bombay, in August. In 1850, at Bombay and in Central India, during the rainy season (June, July and part of August). In 1852, at Almorah, Dehra, Umballah, in May to July; Moradabad, in September. In 1853, in the eastern parts of India, through the winter or cold season. In 1855, at Dinapore, in May; and at no other station throughout that year. In 1861, at Meean Meer, the intensely severe outbreak made its first appearance on 2nd August. In 1863, at Madras and lower part of the Gangetic tract in the early months of the year. Bombay, Agra, Hazarabagh, and Gondah in July; Central Provinces in October and November. In 1864, Central and Western India, in March. In 1867, in the Punjab, in May. In 1869-70, at Thyet Myo, among British infantry in the hot weather (May and June) of each year; Royal Artillery, in the rainy season (July and August), the Indian troops and native Burmese escaping on both occasions. In 1871, at Secunderabad, it appeared on 25th May. In 1872, at Meean Meer, on 31st July. In 1873, as in 1869-70, among the British infantry during

the hot weather; Royal Artillery during the rains. In 1875-6, in the Central Provinces, during the rains (July and August). The sudden occurrence of one or more deaths in the European inhabitants of Calcutta in February, or early days of March, is painfully familiar to residents in that Presidency capital.

14. *In Relation to Natives and Foreigners.*—In 1843, at Agra, the 39th Regiment, and white soldiers of the East India Company's Artillery were severely affected, while the native troops in their immediate vicinity were so in a very slight degree. In 1848, at Dinapore, cholera raged in the 80th Regiment, but in a mild form among the Sepoys and in the native bazaar. In 1853, at the same station and in the surrounding district, it affected the British troops more severely than those of native regiments. In 1861, at Meean Meer, the first person attacked was a native, but the epidemic fell entirely upon the white troops, the Sepoys and the native population remaining almost completely exempt. In 1867, at Shahjehanpore, the British troops suffered severely, so did the native population, but the Sepoys only in a slight degree. In 1871, at Secunderabad, the 18th Hussars suffered; so did a few native residents; the epidemic spared all the other troops, British and native; but having ceased in the Hussars, it attacked the native general population. In 1872, at Lucknow, the British troops suffered, the Sepoys and their native followers remaining exempt. Various other illustrative instances could be given did time and space permit.

15. *In Relation to Certain Other Diseases.*—In 1853, epidemic cholera in Calcutta was followed by the prevalence of a form of fever to which the name of "typhoid" was then given. In 1861, on the other hand, when cholera prevailed at Delhi, the more usual endemic diseases were below their average. In 1869, at Madras, cholera was preceded by "an unhealthy wave"; wounds and ulcers manifested an unusual tendency to become gangrenous. In 1877, cholera and diarrhœa prevailed together in the Wynaad.

In 1844, at Ghazepore, the 29th Regiment suffered severely from fever, the attacks attended by a degree of prostration similar to the collapse of cholera. In the same year, in The Buffs at Meerut, severe attacks of fever often lapsed into cholera. In 1856, at Peshawur, various cases of the severe form of fever prevailing speedily ran into collapse similar to that of cholera. In 1861, at Lahore, Umritsur, and Agra, cholera and intermittent fever

prevailed simultaneously. In 1869, they did so at Peshawur, Umritsir, and various other places. On the banks of the Ganges, however, there was no proportion between the intensity of a malarious epidemic and one of cholera; each attained its climax at a different season of the year from the other. Occasional instances have been observed in which the subject of cholera has presented the yellow tinge of the surface and the black vomit characteristic of yellow fever in the West Indies. Others are familiar, in which the cold stage of intermittent fever lapses into the collapse of cholera, and no less so with "secondary fever", to which the convalescent from cholera so frequently succumbs.

This aspect of the general subject is of sufficient importance to justify the addition of some further illustrative examples, namely: In 1869, at Ghooty, fevers and cholera prevailed simultaneously. In 1872, at Secunderabad, the first person of 18th Hussars attacked was a soldier affected with intermittent fever; in that year also, an epidemic of fever immediately succeeded one of cholera in the majority of military stations in the Bengal Presidency, more particularly at Allahabad, Meerut, Meean Meer; also at Peshawur and Mooltan.

Nor are observations to the same effect confined to the period to which this paper is properly limited; similar remarks are recorded in the years 1477 and 1575. Ancient Hindoo writers allude to similar occurrences in reference to the disease "Jiwar-antishar", believed to have been cholera. Even Hindoo mythology gives prominence to the existence of a similar empirical belief in relation to certain other diseases, personified respectively under the figures of "Oola Beeby"* and "Seetala".

16. *In Relation to Animal Life.*—In June, 1846, it was observed that for some days previous to the outbreak of cholera in the 86th Regiment at Kurrachee, carrion birds, usually numerous around barracks, disappeared; while the epidemic prevailed, some of the dead were buried on the sea-shore, the dearth of wood rendering it impracticable to provide coffins for them; their graves were left untouched by prowling animals (hyænas and jackals), by which such places had on previous occasions been attacked.

Concurrently with the epidemic in South Canara and Malabar in 1869, the coasts were strewn with dead fish.

* Called also "Mahamararee".

At Lucknow, in 1872, the horses of the 19th Hussars suffered from an affection precisely like cholera, then prevailing among the soldiers of that regiment. In 1875, at Delhi, while cholera was epidemic among the troops, seventy-five cats were reported to have died from an affection presenting all the characters of that disease. In the past history of cholera similar examples are somewhat abundantly recorded. [In relation to plant-life, results of observations made in India are not available. Those made elsewhere are on record, showing in some instances the coincidence of blights in cereals with outbreaks of cholera.*]

17. *Whether Contagious and Infectious.*—During the period to which these notes refer, different opinions prevailed among medical officers in regard to contagion and infection, according to the ordinary significance of those expressions: the opinions in question being the outcome of individual experience. Thus, in 1843 and 1844, while cholera prevailed severely in the Buffs at Allahabad, soldiers affected were placed promiscuously in wards, nor did an instance occur in which occupants of adjoining beds were seized by the malady. In 1848, during the outbreak among British troops at Cawnpore, no medical officer or hospital attendant became affected. In 1861, at Meean Meer, the mortality among the soldier orderlies employed in hospitals was great, but medical officers and native attendants altogether escaped. In 1865, during the epidemic in the Madras Presidency, a large proportion of medical officers and of hospital attendants succumbed. In 1875, of sixty-seven hospitals in India in which cholera sick were treated, no attendant was attacked in fifty-nine.

18. *In Relation to Troops in Motion.*—During the same period the occurrence of cholera in bodies of troops on the line of march was so frequent as to point to the act of travelling being itself a predisposing cause of the malady. This liability was recorded to be greater in the Madras Presidency than elsewhere in India; and in that Presidency, most of all in the districts of Bellary, Cuddapah, and Kurnool, the ratio of mortality greater among large bodies than in small. On occasions the attack has occurred while meeting and in contact with bodies of pilgrims; on some it has clung to troops so situated; in others it has ceased on their emerging from the masses of pilgrims. On the one hand, under such circumstances troops affected have

* *Hygiene of Cholera*, p. 167.

been the means of conveying the epidemic to the civil population; in others, the epidemic has extended from the civil population to them.

19. *In Relation to Conservancy.*—During the period under review, the general result of experience confirmed the belief that insanitary conditions of places or persons favour the occurrence of cholera in them; that wherever sanitation was neglected, there cholera, having originated or been introduced, became concentrated and intensified. But experience pointed to the conclusion that insanitary conditions are not, under all circumstances, and by themselves alone, the originating cause of cholera. For example: in 1856 the ravages by the disease were very great at Meerut, a station noted for the excellence of its sanitation; while at Saharunpore, a peculiarly dirty city, few persons suffered. In 1861, at Allahabad, the Wellington Barracks, situated in the worst locality, were exempt; while those situated in more favourable localities were affected. In that year the 52nd Regiment, occupying barracks sanitary in themselves and in situation (in the King's Mews), suffered severely, while the crowded and dirty city of Lucknow was exempt. In 1867, at Lucknow, Meean Meer, and Morar, occupants of localities close to filth pits, and otherwise objectionable, escaped, while those in more "sanitary" positions were affected.

20. *Quarantine by Land.*—Experience showed that in Indian cantonments the strict application of quarantine was impossible. In the Punjab, the people concerned declared that they preferred the cholera to the restrictions implied in that measure. In 1869, it was declared to have failed at the stations to which it was applied. In 1872, some of those in which no quarantine was observed escaped; at others to which it was applied cholera raged violently; for example, at Roorkee strict quarantine was observed, yet cholera occurred there for the first time during seventeen years. In 1875, while cholera was at a distance of forty miles from Salem, Madras Presidency, quarantine was applied in the direction of the point affected, but the epidemic suddenly occurred in that town.

21. *Encamping Troops.*—According to official records, the method of removing troops into camp, and of changing camp grounds during cholera epidemics, was adopted with good results at Madras so long ago as 1774; in the West Indies, during the prevalence of yellow fever, from a still earlier date. Adverting to the period proper, embraced

in the present paper.* In 1843, at Agra, the 39th Regiment was moved from the infected barracks into camp at Rambagh; within a week after that move had been made, cholera ceased in the regiment. In 1848, the 1st European Fusiliers at Cawnpore, and 31st Regiment at Umballah, were moved into camp from infected barracks with the result that in both corps the disease ceased. In 1861, when cholera raged violently among British troops at Meean Meer, a portion of them were marched across the river Ravee and encamped at Shadera: the epidemic thereupon ceased in that particular portion, but continued to prevail among the soldiers left in cantonments. At Umritsur, on the same occasion, no case occurred among the men of the 94th Regiment after they had been moved into camp. At Meerut, with regard to the Royal Artillery and 8th Hussars, and at Agra, with the 42nd Regiment, the move into camp was similarly successful, although the rainy season prevailed at the time.

But not on all occasions was the movement of British troops into camp so successful. In 1845, cholera occurred in the 31st Regiment at Umballah. The effectives were sent into camp during the prevalence of the rains; their tents got blown down, the men, their clothes and bedding were rendered completely wet; during the succeeding night cholera occurred violently among them. In 1856, at Meean Meer, a body of European artillery were marched from infected cantonments to camp; cholera did not appear among them while encamped, but on their return to barracks, forty-eight hours thereafter, cholera attacked some of their number. In 1867, similar measures were adopted at various stations, at some successfully; at others the disease was not checked; while at a few, "evils took place little, if at all, less than cholera itself."

22. *Precautionary Measures.*—Throughout the period referred to in these notes, rules and regulations, the joint result of experience on the part of the higher medical, military and civil authorities in India, have been issued from time to time; whenever cholera threatened or actually attacked British troops, those regulations were most carefully carried out by regimental officers, military and medical, such additional details being supplemented as

* When in 1817 cholera attacked the forces under the Marquis of Hastings, operating between Saugor, Jubbulpore, and Munoola, Central India, the epidemic ceased on the force being moved to the high ground of Gwalior. On that occasion the epidemic seems to have extended from Benares, Allahabad, and Mirzapore.

became necessary by individual conditions. A resumé of such regulations is given in the volume on *The Hygiene of Cholera* already mentioned. In them stress is laid upon the necessity for the early administration of remedies, and full instructions given as to the means by which that measure is to be provided for.

The codes of rules thus alluded to have reference, respectively, to troops in transit by railway and on the march; in cantonments; to conservancy of camps; and to the management of soldiers' families during times of epidemics.

23. *Inoculation against Cholera.*—During the period under notice no case was recorded in which cholera was communicated to man by means of inoculation; that is, by punctures accidentally received while performing autopsies. The blood and evacuations had often been similarly brought in contact with a recent wound without producing evil results.

There is on record only one form of "inoculation" intended to be protective against cholera as having been adopted during that period. This happened between the years 1862 and 1864, at Calcutta, when, at the instigation of Dr. Honigberger, inoculation was performed, the material inoculated being a preparation of Quassia, generally believed to be the simple infusion of that wood. For the time being success was said to follow the process. Within a few months thereafter the subject had passed into oblivion.

24. *Treatment.*—The result of general experience was that only in the early stages of attack by cholera did success seem to reward medical treatment, except in comparatively rare instances; hence arrangements existed regimentally both in barracks and in hospital with that object. Of various methods used, the following epitome represents that which, personally, I was led to consider the most appropriate: namely, calomel, concentrated stimulants, including sulphuric æther, and ammonia, together with carminative tinctures in a suitable vehicle. Diluted medicinal hydrocyanic seemed on occasion to allay gastric spasms, and so enable the stomach to retain those remedies. Frictions to the limbs: *iced* water in small quantities (ice itself not obtainable in the earlier years of the period), warmth externally. The vital powers having shown signs of restoration, they were encouraged by means of continued dry warmth externally, and hot restoratives, medicinal and alimentary, within; these continued till convalescence was

established. Except in the very earliest stage of the malady, opium was omitted. Its use was considered to increase liability to secondary fever.

25. *Summary.*—A careful survey of the data so adduced seems to me to support the deductions therefrom as follows, namely:—

1. That the symptoms or phenomena in an individual case of cholera are definite and characteristic.

2. In certain instances sporadic cases of cholera have immediately preceded an epidemic of that malady; in others, no epidemic has followed.

3. In some instances the sphere of an epidemic was more or less definitely restricted; in others, there seemed to be no definite limit. Outbreaks have occurred simultaneously at places far apart. Their respective degree of incidence has varied.

4. The period of life presenting the greatest liability to attack by cholera would seem to be twenty years and upwards.

5. Varieties have been presented in different epidemic outbreaks in regard to the relative liability of the sexes to cholera.

6. In certain instances the outbreak of an epidemic has been sudden; in others gradual. In some it has quickly culminated and disappeared; in others more slowly, and persisted during longer periods. In another class of instances, an epidemic having moderated in prevalence or mortality has suddenly recurred with increased intensity.

7. The diffusion of epidemics has taken place in various directions, without apparent reference to lines of traffic, or to prevailing winds. The directions recorded include eastward, south, south-west, north, and west.

8. A large proportion of epidemic outbreaks have occurred in places adjoining rivers. In some instances the progress of an epidemic has been downwards along the river course; in others, upwards against the current. The progress of an epidemic has been apparently stopped by the occurrence of a river in its line of progress.

9. Evidence differs in regard to the relation assigned to contaminated water in the causation of a cholera epidemic. Illustrative examples, *pro* and *con*, are given in the text.

10. The observations recorded on the subject of specific "germ" and "poison" in relation to cholera had negative results.

11. Atmospheric conditions during epidemics of cholera

have been various, except with the general existence of an increased hygrometric state.

12. Neither prevailing winds, nor the occurrence of storms such as prevail in India, have had apparent influence on the occurrence or cessation of cholera epidemics.

13. The months of the year during which cholera epidemics were most prevalent included those from March till November. In Bengal, during the earlier part of the year; towards the south-west during the later; in Western India, June, July and August.

14. On many of the instances recorded, British troops suffered more severely during particular epidemics than did the Sepoys or native populace.

15. Observations seem to confirm native belief in the existence of a connection between cholera and the maladies recorded in the text.

16. The occurrence of disease, and of certain unusual phenomena in various classes of the animal kingdom, have been observed during the prevalence of cholera in man. Observations on plants wanting.

17. Certain instances are given indicative of cholera being contagious in those enumerated; others are given which point to this property not being constant under all circumstances.

18. Troops on the line of march are shown to be in an especial degree liable to be attacked by epidemic cholera. They may become infected from the general population, or may be the means of communicating cholera to them.

19. Imperfect conservancy is shown to favour the occurrence of cholera; but instances are recorded in which troops occupying barracks in most "insanitary" positions suffered little, or altogether escaped, while those in more "sanitary" barracks suffered severely.

20. Quarantine has failed at stations in India to which it has been applied; it has at others proved impracticable.

21. The practice of moving troops affected with cholera into camp dates from the eighteenth century. In certain instances the measure has proved successful; in others not so. Minute instructions regarding this measure exist.

22. Minute rules relative to precautionary measures against cholera among troops have also been published.

23. Inoculation of various kinds had negative results.

24. A particular method of treatment, deemed to be relatively successful, is detailed in the text.

Conclusion.—The particulars now submitted have been selected from among such as came directly within my own

knowledge while serving in the capacity of a regimental surgeon in India, or were recorded in official documents which came under my cognisance as an administrative medical officer in that great Dependency. They are here related in the form of bare narrative, such conclusions being drawn therefrom as the data presented seem to justify and support. This being so, I would venture to express a hope that, notwithstanding the high antiquity of the period referred to, the remarks I have dared to formulate may be accepted as a contribution to the literature of what has heretofore proved to be the most extensively fatal and intractable scourge by which, during the greater part of the present century, British soldiers in India, together with their wives and children, have been from time to time afflicted.

ON POST-SCARLATINAL DIPHTHERIA IN THE HOSPITALS OF THE METROPOLITAN ASYLUMS BOARD.

By E. W. GOODALL, M.D., Medical Superintendent of the Eastern Hospital.

(*Read: February* 21*st*, 1896.)

THE secondary diphtheria of scarlet fever has already been made the subject of a communication to this Society, in a paper read by Mr. Sweeting on February 15th, 1893. Mr. Sweeting's paper was entitled "Post-Scarlatinal Diphtheria, a Statistical and Etiological Study", and it was based upon an analysis of the cases published in the Statistical Reports of the Metropolitan Asylums Board. But while the paper dealt thoroughly with such matters as age-distribution, fatality, and seasonal incidence, it did not touch, as the reader himself said, many other questions that arise in connection with the subject. I propose to supplement Mr. Sweeting's paper by giving such further information as may help to throw light upon the origin of this ugly follower of scarlet fever.

Now, at the outset, what are the facts known about post-scarlatinal diphtheria?

(1) It arises usually in patients who have been in the hospital for some time. It is often stated that it occurs most frequently in convalescent patients; but this is not quite correct, for though a patient may have been in hospital for a considerable period, he may be the subject of such grave complications that he can hardly be considered to be convalescent from the disease for which he was originally admitted. Still, it is a fact that the subject of post-scarlatinal diphtheria is very often truly convalescent, and up and about when the secondary disease attacks him.

(2) In its age-incidence it resembles primary diphtheria.

(3) Its fatality is very high, sometimes double that of the cases of primary diphtheria under observation during the same period.

(4) Its occurrence is very capricious. I will give examples of what I mean. In 1893, at the Eastern Hospital,

no case arose between April 20th and August 8th; in 1894, no case between July 19th and Dec. 12th; then between that date and the end of the year eight cases arose in four different wards. Again, the incidence varies much from year to year, as I shall show later. It is also very capricious in its ward-incidence.

(5) To quote from Mr. Sweeting's paper, alluded to above, "There has been a marked increase of the complication at the 'acute' hospitals since diphtheria was received [into those hospitals], although it had undoubtedly existed to a minor extent at some of them before diphtheria was admitted. That at the Northern Convalescent Hospital it has existed both before and after the reception of diphtheria convalescents, and that its prevalence has apparently been inappreciably affected thereby."

When we look more closely into the causes of post-scarlatinal diphtheria some of these facts may be found to help us; on the other hand, some of them require explanation, especially, for instance, the first and the fourth.

In seeking for the origin, in any particular hospital, of the disease in question, we undoubtedly turn in the first place to the conditions of the hospital itself, and for particular cases to the state of the wards in which they have arisen. But though I have frequently looked for them, I have never been able to find any defect of drainage, ventilation, or heating, that adequately explained a single case. I am quite certain that no deficiencies in these arrangements are responsible: Mr. Sweeting expressed the same opinion. As I have no evidence to the contrary to bring forward, I shall not discuss this point further. The next suggestion is that of crowding or overcrowding the wards. The exact signification of the words "crowding" or "overcrowding" varies with the individual who makes use of them. I do not think, therefore, I will venture on any definition. Facts in favour of this suggestion were given by the Medical Superintendent of the South Western Hospital, Dr. Caiger, in his annual report for 1892. He states that in consequence of the great stress on the accommodation for scarlet-fever patients he, for the first time, treated twenty-four patients in a ward that had previously contained eighteen. The floor-space per bed was consequently reduced from 144 to 105 square feet. Within three weeks from the time of the change, no less than seven cases of diphtheria, and three cases of other throat illness, appeared in that ward for the first time in its history—at any rate, since the reopening of the hospital in 1889,

Dr. Caiger therefore removed the six extra beds, and up to the middle of the following March, the date of the report, no further cases occurred in that ward. As regards the South Western Hospital generally, there had been but one case of post-scarlatinal diphtheria recorded before 1892. For that year the incidence on all the cases of scarlet fever under treatment (subtracting those remaining in Hospital at the end of the year) was 0.8 per cent.

My own experience, however, is as follows:—At the Eastern Hospital, during the whole of 1893 and 1894, and up to the beginning of August 1895, over 144 sq. ft. floor-space, 10 to 11 ft. wall-space, and over 2,000 cubic feet, were allowed per bed to the scarlet fever cases. During the latter part of the year 1895 rather less space was allowed, two extra beds being placed in each ward. During 1892 considerably less was allowed. In fact, in my opinion, during the past half year, the wards have been a little crowded, while during 1892 they were distinctly over-crowded. Crowding would be expected, perhaps, to exert an influence in more than one way; not only is there less room for the patients themselves, but there are more patients to catch any secondary disease that may happen to break out. Yet, in spite of these facts, I am bound to say that crowding—nay, that even overcrowding (at any rate, within certain limits)—does not act as a factor in producing diphtheria: with overcrowding the incidence of diphtheria does not necessarily rise. The incidence was greater during the first than during the last half of 1895, and in 1892 was by no means excessive. The incidence on all cases under treatment, subtracting those remaining at the end of the year, was at the Eastern Hospital 1.9 per cent. in 1891, 0.5 in 1892, 0.4 in 1893, 0.8 in 1894, and 4.4 in 1895. The subsequent history of post-scarlatinal diphtheria at the South Western since 1892 has been interesting; the incidence for 1892 was 0.8 per cent. (more than at the Eastern, where there was distinct overcrowding); in 1893 and 1894 it has been 0.7 and 0.9 per cent. So that the immunity enjoyed by the South Western before 1892 has not been maintained. As far as I know, that hospital has not had its wards overcrowded. From these considerations I think there can be little doubt that overcrowding has little, if anything, to do with the occurrence of secondary diphtheria. Dr. Buchanan, in discussing the question in relation to the North Eastern Hospital in 1893, came to the same conclusion (*vide* Appendix to Annual Report of Medical Superintendent for 1893).

A point collateral to that of overcrowding is the influence of the aggregation of acute cases of scarlet fever and of diphtheria in the hospital, by the transference of a large proportion of the convalescents to the convalescent hospitals. Mr. Sweeting, indeed, suggested that this aggregation of acute cases might be one of the factors in the production of post-scarlatinal diphtheria.

As far as the Eastern Hospital is concerned the facts are as follows:—1891, 1,413 cases of scarlet fever were under treatment (not counting those remaining in hospital at the end of the year); 57 per cent. of these were transferred, and the diphtheria incidence was 1.9 per cent.; 1892, 2,902 cases, 66 per cent. transferred, diphtheria incidence 0.5 per cent.; 1893, 2,018 cases, 60 per cent. transferred, 0.4 per cent. the diphtheria incidence; 1894, 1,647 cases, 57 per cent. transferred, diphtheria incidence, 0.8 per cent.; 1895, 1,517 cases, 44 per cent. transferred and 4.4 was the diphtheria incidence. In the years 1891, 1892, 1893 and 1894, the number of diphtheria patients under treatment was 468, 554, 517, and 564, and the percentage of transfers 39, 26, 11, 16. For 1895 the figures are 646 and 21.

As far as these figures go, they are against what I may call the "aggregation of acute cases theory"; for the smaller the proportion of scarlet fever convalescents transferred, the higher the post-scarlatinal diphtheria incidence has been. In fact, were I to found any theory on these figures, it would be one exactly opposite to the aggregation theory; and I should say that the more convalescents I have in the wards the higher the incidence of secondary diphtheria. The experience of the North Eastern Hospital is as follows: For 1893 the cases of scarlet fever there were 3,005, with a diphtheria incidence of 0.3 per cent. In 1894 the figures were 2,104, and 0.7 per cent., and for 1895, 2,293 and 1.6 per cent. (for the figures for 1895 I am indebted to Dr. Birdwood). The proportion of transfers has been 20.6 per cent., 12.9, and 29.6. The proportion of transfers is very much less than at the Eastern, but the diphtheria incidence has increased. The figures are, on that account, rather against the aggregation theory. This hospital, it must be remembered, receives no diphtheria patients. My opinion, based upon the facts derived from the Eastern and North-Eastern Hospitals, is against the suggestion that the aggregation of acute cases of scarlet fever and diphtheria in the same hospital favours the occurrence of post-scarlatinal diphtheria.

The next point to be raised, when considering the effect

of the conditions of the hospital itself, is the possibility of the convection of the virus of diphtheria—that is to say, the bacillus—from the diphtheria to the scarlet wards. Before October 23rd, 1888, practically no cases of diphtheria were admitted into the hospitals of the Board, and there were very few cases of post-scarlatinal diphtheria in those hospitals, with one exception. In the paper I have already referred to, Mr. Sweeting states that "there has been a marked increase of the complication at the 'acute' hospitals since diphtheria was received, though it had undoubtedly existed to a minor extent at some of them before diphtheria was admitted." The suggestion is, that the infection was in these hospitals in some way or other taken from the diphtheria to the scarlet-fever patients. Let us assume for the moment that this suggestion is true. It would be absurd for anyone professing to have an acquaintance with infectious diseases, and their modes of dissemination, to deny this possibility. We know that it is so in the case of many of the infectious diseases—small-pox, for example. In this disease, in fact, there is very strong evidence to show that the virus may be, under certain circumstances, conveyed for a considerable distance through the air in a living and active state. But I am not aware that any convincing evidence has been brought forward in support of a theory of the aerial convection of diphtheria. There is no evidence to show that the incidence of diphtheria is greater in the immediate neighbourhood of a diphtheria hospital than in any other place. So that if the virus is transmitted from one side of the hospital to the other, it must be through some other channel than the air.

As a medium of transmission, one naturally thinks at first of the medical and nursing staff. At the Eastern Hospital, the only persons who daily and habitually visit the wards on both sides of the hospital are the medical superintendent, matron, night superintendent and chaplain. As a rule, the diphtheria wards are visited by these officials before the scarlet fever wards. Different assistant medical officers and nurses are attached to the two sets of wards. The medical officers are occasionally obliged to visit wards other than those of which they have charge; but the nurses are not allowed to do so. But all the nurses from both sides of the hospital meet in common mess- and sitting-rooms. This practice has obtained for the last four years, and, I believe, since diphtheria cases were first admitted. But if the diphtheria bacilli were conveyed by the members

of the staff, I should have expected the cases of secondary diphtheria to have been more evenly spread throughout the year and throughout the wards than they have been; further, I would expect to be able to trace a series of cases to a particular medical officer or nurse. Now I have twice traced a small outbreak of scarlet fever in the diphtheria wards to particular members of the staff who were wearing infected clothing or had not sufficiently disinfected themselves. But I have never—with an exception to be mentioned later, and which comes under a different heading—been able to do so in the case of post-scarlatinal diphtheria in the scarlet fever wards. As regards the nursing arrangements, the work of the hospital has been carried on during the past four years in the same manner, except that during the past half-year the nurses and ward-maids have had more accommodation allotted to them, and are in consequence not so crowded in their own quarters as they were, especially in 1892; yet during the past year diphtheria has been comparatively very rife in the scarlet wards. For similar reasons I am unable to blame the laundry arrangements. Mr. Sweeting, from a comparative study of the various Metropolitan Asylums Board hospitals, came to much the same conclusion with respect to these questions. He could find "no common factor of administrative shortcoming."

It was suggested by one of the members of the Society who took part in the discussion on Mr. Sweeting's paper, that the virus was perhaps conveyed not in a direct manner but in some less obvious way. He suggested that nurses or other members of the staff employed in the diphtheria wards might suffer from slight throat affections, which, though trivial, were really mild attacks of diphtheria; and that these nurses passed on, so to speak, this throat affection—this mild form of diphtheria—to others who were employed in the scarlet wards, and that these latter nurses in their turn transmitted the virus to the patients they were nursing. This is conceivable. For certainly some nurses are very stupid, and will at times, in spite of all they have been told, continue to be on duty with slight sore throats, about which they say nothing for fear they shall be thought to be making too much fuss about a small ailment. For about a year past I have had printed instructions given to every nurse on joining the service, which contains amongst other matters a paragraph insisting upon their reporting themselves to the matron whenever they have the very slightest sore throat. And,

as far I can tell, they have obeyed this instruction very well. Yet, in spite of this, there has been more secondary diphtheria at the Eastern Hospital than ever before. As a matter of fact, I have only once been able to trace any cases to a nurse or any member of the staff. In December, 1894, three cases arose suddenly in one ward, in the persons of three children who occupied adjoining beds. What made me very suspicious concerning the origin of these cases was that all the three patients were confined to bed, being more or less seriously ill with some of the complications that so often follow an attack of scarlet fever. I made inquiry amongst the nurses of the ward (four in number), but none of them were suffering from sore throats. One of them, however, had had during my absence in the previous autumn an attack of sore throat of a doubtful nature, for which she had been off duty several days, but from which she completely recovered. The three patients, who required almost constant attention, were being looked after by this nurse almost entirely. I made a cultivation of a scraping of her faucial mucous membrane, and the result was a growth of diphtheria bacilli of the long variety.

In another case I thought that possibly a nurse had introduced diphtheria into the ward. The ward had been for a period of 129 days free from any undoubted case of secondary diphtheria, and from any suspicious secondary sore throat. Then, during the next ninety-one days seven cases occurred, and no one of these cases was apparently contracted from a previous one. Just about the end of this time, one of the nurses fell ill with a sore throat of a doubtful character. But from the exudation diphtheria bacilli were cultivated. At first sight it seemed as if the nurse had caught diphtheria from one of her patients. But the interesting point is that she herself had had—so she very positively declared, as an argument against her sore throat being diphtherial—an attack of diphtheria about two years previously. Her tonsils were hypertrophied. The question arose in my mind, Were diphtheria bacilli present in her throat all this time? It may be remembered that Dr. Gresswell brought before the notice of the Society some facts to show that occasionally persons who have an attack of diphtheria become the subject of chronic or relapsing sore throat, the second attacks or relapses occurring at intervals of several months; and that these second attacks gave rise in other persons to diphtheria. I have had brought to my knowledge during

the past year another such case of apparent latency of the diphtheria bacillus. In January of last year a nurse had an attack of very mild diphtheria: so mild that it would almost certainly have been put down as a simple tonsillitis, if diphtheria bacilli had not been demonstrated in a scraping from the surface of the tonsils. She was kept off duty and isolated for several weeks, on account of the persistency of the bacilli. When apparently free from infection, she was put in charge of a ward devoted to mixed scarlet fever and diphtheria. She went home for a short time after being discharged. In the autumn she went home again on her annual holiday. Her home was in a village in Oxfordshire, from which diphtheria had been absent for certainly a very long period. A few days after this nurse arrived home, her sister sickened with diphtheria, and died, and a niece had a mild attack. I was told that the nurse herself suffered from sore throat, stated by the medical attendant not to be diphtheria, four days after her sister died. It looks as if in this case the bacilli were rousing themselves to fresh activity just about the time the nurse went home. These are the only examples that I have met with since I have been on the look-out for them, some three years, of instances in which a nurse has seemed to convey diphtheria to others; and it will not have escaped notice that in each of these three cases the nurse herself had previously been the subject of diphtheria. A nurse who has had small-pox, typhus, enteric or scarlet fever, has her value distinctly enhanced by that fact; but it may be a question whether a nurse who has recently had diphtheria is altogether desirable, except for the purpose of nursing diphtheria patients.

So far I have been dealing with the hospital arrangements and their relation to the occurrence of post-scarlatinal diphtheria, and I have been bringing forward what positive evidence I have to support the view that the virus is conveyed from the adjoining diphtheria wards; and the positive evidence is limited. But there is another channel by which a scarlet fever ward may become invaded by diphtheria, and one which was not alluded to in the paper I have already quoted. The association that exists between these two diseases is well known. Both may be present at one time in one place; the different members of a family, or inhabitants of the same house, may suffer, some from undoubted scarlet fever, others from undoubted diphtheria. Several instances of this nature will be found in the reports for bygone years of the

Medical Inspectors of the Local Government Board. I have observed the association several times. For the past two years, two large workhouse schools have been sending, off and on, cases of both diseases to the Eastern Hospital. The question, therefore, naturally arises, Do the two diseases coexist at the same time in the same person? A diphtheritic throat, using the words to mean a throat like that of diphtheria, is common enough in scarlet fever. But there are reasons for believing that a large proportion of such cases are not cases of true diphtheria complicating scarlet fever. Even if they were, they would not give rise to much difficulty with respect to the occurrence of post-scarlatinal diphtheria. When I first went to the Eastern Hospital, I thought that very possibly these anginous forms of scarlet fever were mixed cases of scarlet fever and diphtheria; and a ward was set apart into which nearly all such cases were sent immediately on their arrival at the hospital. But further clinical observations, combined later with bacteriological evidence, led me to abandon, or at any rate considerably modify, this view; and about March, 1893, the ward having been cleaned, was used for any cases of scarlet fever, and these particular anginous cases were not, as a rule, kept separate from the rest. During 1892, the incidence of post-scarlatinal diphtheria was less than in 1891 (0.5 against 1.9 per cent.); in 1893 it was 0.4, and in 1894, 0.8. That is to say, there was little difference between 1892, 1893 and 1894 in this respect. Occasionally, no doubt, one of these cases is truly a mixed case. But one generally has suspicions in such examples, and isolates the patient. Again, typical cases of diphtheria, unaccompanied by any symptoms of scarlet fever, are not infrequently sent up to the hospital with a certificate of scarlet fever; but such cases are usually detected at once, and are not sent to the scarlet wards.

There is another class of case which may be the means of introducing diphtheria into a scarlet ward—I mean very mild cases of diphtheria. It is common to get patients sent to the hospital with a certificate of scarlet fever and a history of illness of some days' duration; but on their arrival no very definite signs of scarlet fever are to be observed, and the throat affection has often, too, disappeared. My own opinion is that some of these cases may be diphtheria. I have had some good examples of this class of case within the last fortnight. From one of the two schools to which I alluded just now, six patients have been sent to the hospital with a certificate of scarlet

fever. Two of the children had well-marked scarlet fever; two had pretty well-marked diphtheria; the remaining two appeared to have little the matter with them. They have all been examined once for diphtheria bacilli; but in only two of the six these have been discovered: in one of those diagnosed as diphtheria on admission, and in one of the doubtful cases. This patient has within the last few days developed paralysis of the palate. Had I not been on my guard by former experience of the schools with respect to these cases, it is very probable that three or four cases of true diphtheria would have been sent into scarlet wards.

It is generally thought that the scarlet convalescent patient is particularly susceptible to diphtheria; and I suppose that, compared with other diseases, whether general or local (of the throat), this is true. But patients must vary very much as regards individual susceptibility. I have twice known a case of diphtheria to be for upwards of four weeks undiagnosed in a scarlet fever ward, it having been accepted as scarlet fever in the first instance, but to have declared itself diphtheria by the event of typical paralysis. These two patients were up and running about the wards for some time before the paralysis came on; yet in neither instance did diphtheria manifest itself in any of the convalescent scarlet patients. In 1892, when, as I have previously mentioned, one ward was set apart for cases regarded as mixed scarlet fever and diphtheria, this ward was continuously filled by three sets of patients—(i) cases of scarlet fever which on admission seemed also to be suffering from diphtheria (we had no bacteriological apparatus in those days, and had to rely entirely upon clinical methods of diagnosis); (ii) cases of diphtheria arising in convalescent scarlet fever patients; and (iii) cases of scarlet fever arising in convalescent diphtheria patients. Now, of the first class I have no doubt whatever that a considerable number were rather severe cases of scarlatina only; they were thrown into intimate association with many cases of indubitable diphtheria; yet only one of these cases developed secondary or post-scarlatinal diphtheria. On the other hand, I have known several such cases arise from a malignant diphtheria case sent in error to a scarlet ward.

In order to find out what proportion of patients certified to have scarlet fever have diphtheria bacilli in their fauces, I last year examined a series of patients—100 in all—who were sent up to the hospital certified to have scarlet fever.

Of these 100 patients, eighty-seven had scarlet fever; and of these, in six there were diphtheria bacilli of the long variety, though in two of these six the number of bacilli were small compared with other organisms. In thirteen cases the short variety only of the bacillus, or organisms indistinguishable from it, were found. Of the thirteen other cases, two were cases of diphtheria (one of these was diagnosed clinically), five were cases of rötheln, in one of which the short variety of the diphtheria bacillus was found; three were cases of measles, one a case of pneumonia with the short variety of diphtheria bacillus, one a case of diarrhœa, and one a case of tuberculous meningitis.

The cases of scarlet fever in which diphtheria bacilli were found were most of them very mild cases, and would not have been clinically diagnosed as mixed scarlet fever and diphtheria. It is quite clear, therefore, that the scarlet fever patient may introduce diphtheria bacilli into a scarlet ward.

One of the patients in whom diphtheria bacilli of the long variety was found, subsequently developed post-scarlatinal diphtheria. Four of them in whom no bacilli were found were subsequently affected in a similar way.

I may add that, in my opinion, cases of mixed scarlet fever and diphtheria have been more frequent during the past two years than during the two previous—going by the clinical histories of the cases as much as by bacteriological evidence; and these cases are on the increase.

Post-scarlatinal diphtheria has attracted attention chiefly from the point of view of hospital administration, and especially of fever hospital administration. But it should not be forgotten that it occurs in private practice, or, at any rate, in patients before their removal to fever hospitals. From time to time I have admitted to the hospital patients who, besides being the subject of diphtheria (usually of a severe type), also exhibit certain signs of having recently been through an attack of scarlet fever. In some cases, indeed, they are certified to be suffering from that disease as well as from diphtheria, and information is given of the attack of scarlet fever that has preceded the diphtheria. Beyond the fact that I have seen a fair number of such cases, I do not know what proportion of scarlet fever patients in private practice develop subsequent diphtheria, nor do I know under what circumstances the secondary disease arises. Dr. MacCombie has pointed out this occurrence of post-scarlatinal diphtheria in private practice in

two or three of the recent Annual Reports of the South-Eastern Hospital. He has also, in the same Reports, drawn attention to the frequent combination of the two diseases in the acute stage.

Scarlet fever is by no means the only disease that is complicated by diphtheria. Measles, whooping-cough, enteric fever, pneumonia, tuberculosis and small-pox, may all be accompanied by it. But of these diseases, measles is the one in which the combination is most frequently met with. Usually diphtheria arises during the acute stage of measles, but not infrequently it comes on during the period of convalescence. Of eighty-three cases of measles sent up to the Eastern Hospital during 1892, 1893, and 1894, 17 or 20.4 per cent. were complicated with diphtheria before admission; while of 100 cases of measles arising amongst scarlet fever convalescents during the same years, nine had diphtheria. If I were to judge by my own experience, I should say that diphtheria more frequently complicates measles than it does scarlet fever. But even if this is not true, the combination of the two diseases is sufficiently frequent to be noteworthy. And inasmuch as the case-mortality of these cases is extremely high (of the twenty-six cases I have had under observation twenty-three died), it is worth consideration by those who seem anxious to recommend the erection of hospitals for the isolation of measles on a large scale, whether, as far as the patients are concerned, it would not be sending them out of the frying-pan into the fire: for my own impression is that post-morbillous diphtheria would be much more frequent in its incidence in such hospitals than post-scarlatinal diphtheria—at any rate in the metropolis—and it would certainly be very much more fatal.

And these words—"in the metropolis"—bring me to the exposition of what I believe to be the explanation of post-scarlatinal diphtheria in the fever hospitals of London.

Mr. Sweeting, in the paper from which I have already quoted, suggested that the small amount of diphtheria occurring at the South-Western Hospital before 1892 might be associated with the greater rigidity of separation of the nursing and medical staff at that hospital. And he went on to say: "The association is worth noting with a view to the important suggestion (which might be made) of a totally distinct administration for diphtheria. I am not aware if this has been yet tried in this country. If it were, it would settle the etiological point as to whether post-

scarlatinal diphtheria is due at 'acute' hospitals to mediate infection by an imperfectly separated staff." Though the writer did not say so in definite words, yet a careful perusal of the paper leads me to think that his explanation of post-scarlatinal diphtheria was that, somehow or other, the infection was conveyed from the diphtheria to the scarlet side of the hospitals. Now, since Mr. Sweeting's paper was read, we have had before us additional evidence on the subject. We know that the South-Western Hospital still continues to suffer to much the same degree as some of those hospitals in which this secondary diphtheria had made its appearance before; and we also have had made, in the case of the North-Eastern Hospital, the very experiment to which Mr. Sweeting alluded.

The peculiarity of the North-Eastern Hospital is that it receives no diphtheria patients. It has been set apart for scarlet fever entirely. Yet, as I have already mentioned when discussing the influence of the aggregation of acute cases of scarlet fever, post-scarlatinal diphtheria made its appearance during the first year the hospital was opened, and has been increasing since that time, the incidence* being 0.4 per cent. in 1893, 0.8 in 1894, and 2.0 in 1895. On looking at the tables given in Mr. Sweeting's paper, it will be found that this incidence (especially for 1895) exceeds that for the "acute" hospitals before 1888, and does not differ much from that of the Northern in some years. In 1895 the incidence at the North-Eastern is almost the same as that for the North-Western in 1889, 1890, and 1892, and not much below that for 1891; and it must be remembered that the North-Western has a considerable portion of its beds devoted to diphtheria. The experience, therefore, of the North-Eastern Hospital absolutely goes against the suggestion that the addition of diphtheria wards to the various fever hospitals in London has been the cause of post-scarlatinal diphtheria in these hospitals. The example of the Northern Hospital and of the Gore-Farm Hospital is also against this view. In the former hospital, post-scarlatinal diphtheria had manifested itself before diphtheria was received into any of the "acute" hospitals, let alone into the Northern, and to the Gore-Farm Hospital diphtheria convalescents have never been taken. Now any theory of post-scarlatinal diphtheria must explain these cases.

I have placed in the following table (Table I) the inci-

* Calculated according to Mr. Sweeting's method; see page 82.

dence of diphtheria in the Metropolitan Asylum Board's hospitals since 1886. I have obtained the information from the published reports of the Board, but for some of the facts I am indebted to Mr. Sweeting's paper. For each year the incidence is calculated on all the scarlet fever patients under treatment, subtracting those remaining in hospital at the end of the year. I have also entered the number of diphtheria admissions for each year. In the last column but two, on the right-hand side, are the number of cases of croup and laryngitis, not called diphtheria, occurring amongst the scarlet cases. It is worthy of note that the percentage of these on the total cases of secondary throat complications (see last column but one) was much higher for the years 1886, 1887, and 1888, than it has ever been since: a fact which might give rise to the suggestion that some of these cases are really cases of diphtheria. In the last column is the percentage of all cases of secondary diphtheria, membranous croup and tonsillitis, croup and larnygitis, on the total cases of scarlet fever.

TABLE I.

—	Scarlet Cases under Treatment.	Diphtheria Admissions.	Cases of Secondary Diphtheria.	Percentage Incidence of Secondary Diphtheria.	Cases of Secondary Laryngitis and Croup.	—	Percentage Incidence of Diphtheria, Laryngitis. etc.
1886	1,559	—	7	0.4	9	60.0	1.0
1887	4,342	—	18	0.4	29	61.7	1.0
1888	5,717	99	67	1.1	39	36.7	1.7
1889	3,739	772	102	2.7	17	14.2	3.1
1890	6,439	942	158	2.4	21	11.7	2.7
1891	5,442	1,312	97	1.7	41	29.7	2.5
1892	11,333	2,009	211	1.8	81	27.7	2.5
1893	14,832	2,848	207	1.3	59	22.0	1.7
1894	12,636	3,666	210	1.6	41	16.3	1.9

(Under the head of diphtheria are included all cases of membranous croup, croupous laryngitis, and croupous tonsillitis. The last column but one shows the percentage of cases of secondary laryngitis and croup on the total cases of secondary throat affections.)

It will be observed that the rise in the incidence of diphtheria began in 1888. Diphtheria patients were admitted into the hospitals of the Board on Oct. 23rd of that year. Sixty-seven cases of secondary diphtheria occurred during the year, and of these at least fifty-two arose before Oct. 23rd; thirty-six of the cases were in the "acute" hospitals, and at least thirty-two of these arose before Oct. 23rd.

I think, therefore, it may be stated that the occurrence of post-scarlatinal diphtheria was noticeable before the hospitals began to receive diphtheria patients.

I may here point out, *en passant*, what I consider to be the erroneous method of calculating the incidence of post-scarlatinal diphtheria adopted by Mr. Sweeting. He calculates it for each hospital upon what he terms the completed cases—that is, the discharges and deaths, and he does not include patients who are transferred. The result is that the incidence appears for some hospitals to be very much higher than for others. And if you take the case of each of the "acute" hospitals separately, it makes it appear as if after 1888 there had been an enormous increase in the rate of incidence. I submit that the proper and fair method of calculating the incidence is to take the total number of cases under treatment, omitting only those remaining at the end of the year. An example will show more clearly what I mean. We will take the extremes, and suppose two hospitals, one of which transfers all its convalescents, while the other transfers none. Suppose each has under treatment during the course of the year 1,200 cases of scarlet fever; that 50 patients die; and that 100 remain under treatment at the end of the year. And suppose that in each hospital there are ten cases of secondary diphtheria. Then the one hospital which transfers 1,050 convalescent patients will have, according to the method which reckons only discharges and deaths, an incidence of post-scarlatinal diphtheria of 20 per cent., while the other, which directly discharges 1,050 patients, will have an incidence of 0.9 per cent. Calculated on the number of patients under treatment, minus those remaining in hospital at end of year, the incidence in each hospital is 0.9 per cent. Strictly speaking, the number of diphtheria cases arising amongst the transferred convalescents should be counted in with those of the "acute" hospital from which these patients were transferred. But it is impossible to do this, because in the report of the Northern and Gore-Farm Hospital it is not stated from which hospital each patient came. When you calculate the incidence for all the hospitals together, errors of this kind are eliminated. But I observe that Mr. Sweeting does not give any table showing the incidence of the disease upon all the hospitals together.

I have mentioned that in October, 1888, the Metropolitan Asylums Board began first to take in diphtheria. I presume the managers of the Board were induced to take

this step on account of the prevalence of that disease. At any rate, it is a fact that in that year diphtheria, judging by the number of registered deaths, was much more prevalent in London than it had been before. In his annual summary for 1888, the Registrar-General wrote as follows: "The mortality from this disease (diphtheria) has apparently been increasing in London since 1877, having risen from 0.09 per 1,000 in that year to 0.30 in 1888. *The rise up to* 1887 *was gradual; but in* 1888 *there was a sudden bound,** the deaths increasing from 953 to 1,301, and the rate from 0.23 to 0.30, a rise of 30 per cent. in a single year." As the table (Table II) of death-rates per million living, which I append, shows, the deaths from diphtheria, and presumably the number of cases, have been high since 1888, and have especially increased during the last three years.

TABLE II.

Annual Death-rate per million living from Diphtheria in London.

1884 ...	241	1888 ...	319	1892 ...	462
1885 ...	227	1889 ...	391	1893 ...	760
1886 ...	212	1890 ...	331	1894 ...	614
1887 ...	235	1891 ...	340		

The point I wish to emphasise, however, is that there was a sudden increase of diphtheria in London in 1888; that in that year there was also marked increase in the incidence of post-scarlatinal diphtheria in the Metropolitan Asylums Board hospitals, and that into these hospitals only ninety-nine cases of diphtheria were admitted between October 23rd and the end of the year.

Of the actual number of cases of diphtheria in London we have no data, beyond the number of deaths, till after the Notification Act. For 1891, 1892, 1893 and 1894, the case-rate of this disease was .15, .20, .32, and about .25 per cent. respectively (see Table III). This rate is calculated on the total population.

TABLE III.

Case-rate of Diphtheria in London.

1891 ...	1.5 per 1,000	1893 ...	3.2 per 1,000
1892 ...	2.0 ,,	1894 ...	2.5 ,, (about).

The following table (Table IV) shows the case-rate per cent. for the lower ages, males and females, during the year 1893:

* The italics are mine.

TABLE IV.

(*From the Report for* 1893 *of the Medical Officer to the London County Council.*)

	Males.	Females.
Under 1	.27	.25
1— 2	.91	.70
2— 3	1.01	.97
3— 4	1.21	1.18
4— 5	1.18	1.22
5—10	.70	.82

For 1893 the percentage incidence of post-scarlatinal diphtheria was 1.3 in the Metropolitan Asylums Board's hospitals—very little higher, that is to say, than the incidence of diphtheria on all the children in London between the ages of one and ten. A very large proportion of the scarlet fever patients admitted into these hospitals are under ten years of age; for the year in question—1893—of 14,548 admissions, 9,890, or 67 per cent., were children under ten.

There is one other point which I wish to lay before you in connection with the subject. It is well known that of late years the hospitals of the Metropolitan Asylums Board have become increasingly the receptacle of the scarlet fever patients of the metropolis. This was noticed as far back as 1885 by the Registrar-General in his annual summary. But it has been much more the case of late years. The following table (Table V) shows the percentage of deaths from scarlet fever in the Metropolitan Asylums Board and London Fever Hospitals to the total deaths from the same disease since 1878:

TABLE V.

1878	7 per cent.	1888	43.4 per cent.
1879-82	9 to 11 „	1889	48.9 „
1883	13.2 „	1890	62.2 „
1884	17.6 „	1891	60.0 „
1885	20.2 „	1892	69.0 „
1886	22.7 „	1893	58.0 „
1887	36.6 „	1894	74.0 „

From this table we see that from 7 per cent. in 1878 the proportion of deaths in hospitals rose to 74.0 in 1894. But from 1878 to 1886 the increase was gradual. In July of 1887, the Local Government Board issued an order authorising the admission of patients upon the order of a relieving officer, or master of a workhouse, accompanied by a certificate signed by a poor-law medical officer, *or by any registered medical practitioner.** Perhaps in conse-

* The italics are mine.

quence of this order the proportion of patients admitted to the hospitals rose; at any rate, the proportion of deaths in hospitals went up from 22.7 to 36.6 per cent. The Notification of Infectious Diseases Act of 1889, and the Public Health Act (London), 1891, tended still further to increase this proportion. The latter Act removed the stigma attaching to pauperism, which previously lay upon all admitted to the Metropolitan Asylums Board hospitals. The result of this increased admission of scarlet fever patients into these hospitals has been that the mild and doubtful cases have been swept in along with the well-marked, and in larger numbers than before—the cases, I mean, that I have mentioned in a previous part of this paper as being very probable sources of diphtheria. This, and the aggregation of much larger numbers of patients (chiefly children) than in previous years, afford very favourable conditions for the introduction and spread of diphtheria amongst the patients; and I certainly think that, considering that these conditions were especially coming into operation at a time when diphtheria was markedly on the increase in London, they have had no slight influence on the occurrence of post-scarlatinal diphtheria. Not only, too, have we in the case of hospitals an aggregation of children, but we have an aggregation of children suffering from sore-throat. I think the fact that this secondary diphtheria was observed at the Northern Hospital to a greater extent than at the "acute" hospitals before diphtheria was received into them, is quite in accordance with these suggestions. The patients, being convalescent—and, indeed, most of them apparently well—were allowed more freedom, and not supervised and kept apart so rigidly as those in the "acute" hospitals, many of whom were still being kept in bed. Hence the conditions for the appearance of diphtheria were more favourable at the Northern than at the "acute" hospitals. The virus, I have no doubt, was conveyed *viâ* the "acute" hospitals.

To recapitulate briefly the main points of this paper. Post-scarlatinal diphtheria has been noticeable in the hospitals of the Metropolitan Asylums Board since 1887. In 1888 diphtheria patients were first admitted to these hospitals. It may be, and I think I may say it has been, suggested, that in some way or other the occurrence of diphtheria amongst the scarlet patients has been due to the presence of these diphtheria patients. There is no positive evidence, however, to show that the virus of diphtheria is carried from the diphtheria wards to the scarlet

wards; nor is there any evidence to prove that it is due to any structural defects in the buildings, or to overcrowding. But at the very time that post-scarlatinal diphtheria began to be noticed in the Board's hospitals, diphtheria became, as far as can be ascertained by a consideration of the registered deaths, very much more prevalent in London than it had been before. About the same time the number of patients suffering from scarlet fever admitted to the hospitals began to rise very considerably, and a larger proportion of doubtful cases began to be sent in. The question, therefore, of the occurrence of diphtheria amongst scarlet fever convalescents in hospitals is but part of the much larger question of its behaviour in London generally during late years.

BACK-TO-BACK HOUSES.

By ARNOLD EVANS, M.D.

(*Read: April 17th*, 1896.)

In treating of the influence of the different kinds of dwellings for the labouring classes upon the health of those who live in them, I shall not refer to the block buildings that have been erected for the housing of the poor in the central and crowded parts of some of the large towns. Of these I have no experience, and they have not been erected in that part of the country, viz., the West Riding of Yorkshire, to which my remarks more particularly apply. The houses of which I shall speak are those built for the average artizan, and intended for the use of one family only, usually described as "self-contained".

In Bradford the houses inhabited by the working classes consist of two principal types, commonly known as (1) "Through-and-through", and (2) "Back-to-back".

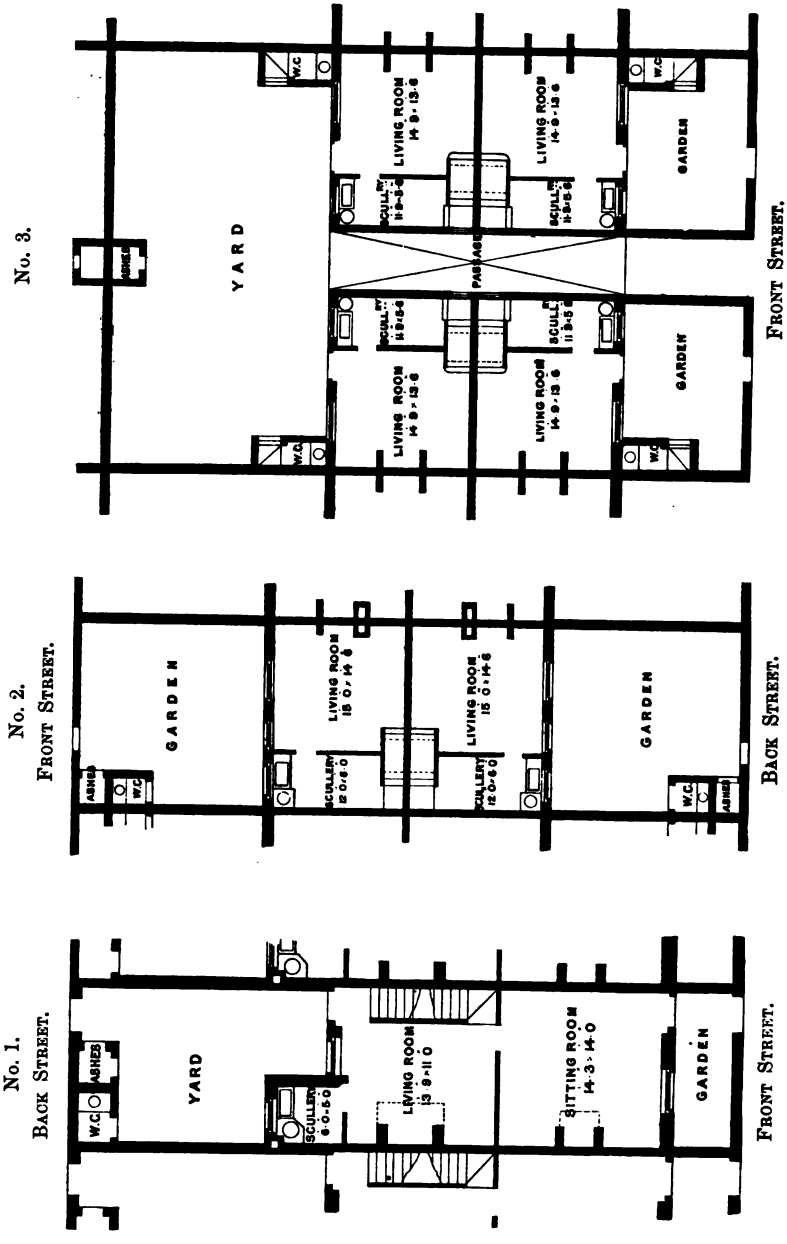
The manner of construction will at once be appreciated by a glance at ground plans of three of the houses:—

No. 1 represents the ground floor of a "through" house. This plan shows one house of a row. You will see that it has vacant space on two sides, the back and the front; that it also possesses a back and a front door, in which two particulars it differs essentially from a house built on the back-to-back plan. This type of house is the one which is now most in favour amongst persons of small means. In addition to two living rooms on the ground level, it contains two bedrooms on the second floor, and above them an attic lighted by means of a skylight.

The sanitary appurtenances consist of a water-closet and a place for dry ashes, situated in the yard at the back of the house, the ashes place being emptied by means of a door in the back street. But in many of the older houses the midden privy, I regret to say, takes the place of the W.C. and dry ash place.

Nos. 2 and 3 are the ground plans of two kinds of houses erected on the back-to-back principle.

The older style of building is represented in plan 2. The house consists of one living room on the ground floor, to


No. 1.
Back Street.
W.C.
ASHES
YARD
SCULLERY
6·0·5·0
LIVING ROOM
13·9·11·0
SITTING ROOM
14·3·14·0
GARDEN
Front Street.
No. 2.
Front Street.
ASHES
W.C.
GARDEN
SCULLERY
12·0·6·0
LIVING ROOM
15·0·14·6
LIVING ROOM
15·0·14·6
SCULLERY
12·0·6·0
GARDEN
W.C.
ASHES
Back Street.
No. 3.
ASHES
YARD
W.C.
W.C.
LIVING ROOM
14·9·13·6
SCULLERY
11·9·6·6
PASSAGE
SCULLERY
11·9·6·6
LIVING ROOM
14·9·13·6
LIVING ROOM
14·9·13·6
SCULLERY
11·9·6·6
SCULLERY
11·9·6·6
LIVING ROOM
14·9·13·6
W.C.
GARDEN
W.C.
GARDEN
W.C.
Front Street.

which is attached a small scullery, situate sometimes on one side: sometimes on another. Above are generally two bedrooms. These houses are built in rows of about thirty to forty houses, the party walls consisting of a 9-in. brick wall. It is further seen that each house faces a main street, and has all the vacant land attached to it on one side: two material points in which it differs from the third group. The out-offices, consisting either of a midden privy or water-closet and dry ash place, are fixed on that part of the land attached which is most remote from the house and next the street.

The third type of back-to-back house is shown on plan No. 3; they are euphemistically described by builders as "blocks of four"; they would be more correctly designated as houses built in continuous rows, with passages between every four, the passages only extending to the height of the first storey, and being made with the double object of permitting access from the street to the house and appurtenances in the rear, and of promoting the circulationof air.

Examination of the ground plan shows that one house faces directly on to the street, is bounded on one side by the wall separating it from the next house, and on the other side by the passage; this house is therefore a considerable distance from the privy, which can only be reached by passing into the street and proceeding down the passage. The scullery, containing the slop sink, is placed on the side of the house next the passage, and is lighted by a small window facing either the street or the side passage. The piece of land attached to the houses exists in the form of the passage already mentioned, and a yard into which the door of the house in the rear opens. In the yard are situated sanitary conveniences for the whole of the houses, consisting usually of four privies and two ash pits for each so-called "block of four". (In the plan shown the sanitary offices are differently located, but very few houses have been built in accordance with this improvement.) The houses are only built to the height of two storeys, and some have two and some three bedrooms. The result of this style of building is that the house facing the street is a considerable distance from the out-offices, of which the persons living in the houses situate in the rear have an excellent but unenviable view, and as in the majority of instances there are no back streets, there exists a double row of privies (generally midden privies) between two rows of rear houses.

The sanitary evils necessarily connected with back-to-back houses will therefore be obvious. Owing to the

absence of a door at each side of the house a through current of air is an impossibility: a serious fault which I cannot persuade myself is in any way mitigated by the presence of a window in the passage, which, in point of fact, is very seldom opened, and, when it is, becomes the means of ventilating the scullery and slop sink into the living room. There must, in houses built on this plan, be a part of the room next the party walls exceedingly difficult to ventilate; and that ventilation, at all events in any appreciable degree, does not occur through the party walls themselves, is, I think, shown by the fact that when one house is fumigated with chlorine gas or sulphurous acid, it has seldom happened that the smell characteristic of these gases has been noticed in adjoining houses.

How it ever came about that house-building was commenced on such a perverted plan is difficult to understand, and still more difficult to explain how, after the evils of back-to-back house construction had made themselves manifest, the system should have so long been in vogue.

The only explanation that suggests itself to me is that some ingenious architect or builder found, that by such an arrangement, he could erect five or six houses on the back-to-back plan on the amount of ground requisite for only four through and through houses, and thus economise space. But, owing to the adoption of improved building bye-laws in some of the West Riding towns, more land is required for the erection of back-to-back houses, so that this reason no longer exists; which fact, coupled with the growing demand on the part of the working classes for small through houses, has led to a more or less general abandonment of this method of construction.

Referring to the relative proportion of back-to-back and through houses, Dr. Barry and Mr. Gordon Smith, in their well-known report say, when writing of Bradford, that "we find that in the eleven years, 1876 to 1886, out of a total of 7,036 new houses certified as fit for habitation (by the Medical Officer of Health), 4,486, or 64 per cent., were built on the back-to-back plan; or, in other words, during the eleven years, 1876 to 1886, new dwellings unfurnished with means for through ventilation were provided in Bradford for over 20,000 persons.

"When, in addition to the facts already stated, we remember that in all the large manufacturing towns of Yorkshire back-to-back dwellings have been, and still are being, built to a very considerable extent, the vital bearing of this inquiry upon the health and well-being of so con-

siderable and important a section of the population will be manifest."

Dr. Barry and Mr. Gordon Smith further state that "it is a significant fact that, during the recent survey made by the Inspectors of the Medical Department, it was found that in the manufacturing districts of Lancashire, in the Potteries and in the Black Country, where dwellings of the back-to-back class had formerly prevailed to a very considerable extent, the system of building houses unprovided with means for through ventilation has been almost entirely discontinued."

Although in Bradford the further erection of back-to-back dwellings is practically prohibited, and the requirements of the Building Committee such as will only allow of the construction of through houses, the direct cause of this improved state of affairs is so curious, that it is worth while to pay some little attention to the history of the housing of the working-classes in this town. I will quote at some length from a report made for the Local Government Board, about the year 1880, by Messrs. Netten Radcliffe and Gordon Smith. They state that: "In 1862 the Corporation of this borough, in view of the sanitary evils attaching to back-to-back houses, passed a bye-law which would have the effect of putting a stop to the building of this class of dwellings in the borough. This bye-law was maintained in operation for seven years, when the policy which had given rise to it was reversed, the bye-law rescinded, and the erection of back-to-back houses again permitted. The circumstances which brought about the retrograde action of the Corporation on this important question appear to have been somewhat complex, and the opinions entertained on the subject by those who are placed in a position to judge best in regard to it are not uniform. While some are disposed to attribute the greatest importance to local prejudice in favour of back-to-back houses influencing municipal action, others hold that the issue had in reality been governed solely by the questions of cost and rental with reference to the wants of the wage-earning classes, and that other questions had been altogether subsidiary to this one.

"It is necessary here to anticipate a misapprehension which might else arise if the rescinding of the bye-law of 1862 were to be regarded simply as a return to the state of things with regard to the building of back to-back-houses which had existed before the bye-law of 1862 came into operation. Such was far from being the case. The Cor-

poration, while yielding to what it deemed a necessity in reverting to back-to-back construction, resolved to submit new back-to-back houses to certain regulations, conceived with a view of diminishing to the utmost the sanitary evils attaching to them. These regulations provide for a larger amount of space about back-to-back as compared with through-and-through houses, and by perforation of rows of these houses by broad passages in the ground storey to facilitate the movement of air about them, and to permit of the out-offices being placed in a position less liable to render them an offence and to become mischievous to health. In other words, the regulations, by securing a larger space and freer circulation of air, and to some extent a less harmful disposal of filth in the vicinity of the houses, seek to obviate the extrinsic evils which have usually co-operated with the intrinsic evil of defective ventilation in producing the unwholesomeness of back-to-back houses. The adoption of this policy, in conjunction with the growing wishes of the wage-earning classes to have more commodious (even if back-to-back) houses, has exercised a remarkable effect upon the construction and arrangement of the newer back-to-back houses in Bradford. Indeed, so great is the change that it became necessary for us to study the back-to-back houses built since 1870 from a different sanitary point of view than that which is commonly entertained regarding houses of this class, and with which we had entered upon the inquiry. The building regulations at present in force require an open space, 6 ft. 6 in. wide, and of a height not less than that of one storey, to be kept between every four houses arranged in pairs, two in front and two in the rear. Under this arrangement, in the plan most approved by the Corporation, rows of back-to-back houses of infinite length may be constructed with a passage of the width and height described above between every two pairs; and it is alleged that this plan, considered with reference to the amount of space required to be left about each two pairs of houses, admits of the free circulation of air around the houses. Further, by means of the additional window or door opening into the passage at the side of each house, it is believed that facility is given for a free passage of air through the living rooms of the house. This class of back-to-back house has been largely adopted in the newer parts of Bradford.

"Back-to-back houses of the kind here described were made the subject of close study by us in respect to their sanitary practicabilities, so far as this could be followed

out without the aid of statistical evidence of sickness and mortality touching the occupants. As the result of this study, we have to admit that the sanitary condition of the back-to-back houses, built according to the regulations above described, differs very considerably from what we were prepared to find.

"As to the exterior ventilation of the houses, a change has been wrought of the most important description. On account of the large space around them, and the perforation of the rows at short intervals by the passages, the abolition of closed courts, and further, it must be added, the introduction of more cross streets (the length of the rows being in this way controlled after a fashion), opportunities for much freer movement of air have been afforded about the buildings, and inferentially within them. So long as the ordinary midden privy is retained (in whatever manner it may be improved in structure and regulated), such purity of air in the vicinity of buildings as is desirable and capable of being obtained will not be got. But the greater freedom in the movement of air about the buildings which, is now being secured, together with a better arrangement of the privies, has very manifestly diminished privy nuisance. It appeared to us quite obvious that, when Bradford shall have adopted a privy system worthy of so important a Corporation, the conditions for keeping wholesome the atmosphere about the newer back-to-back dwellings will probably have been carried to almost as great an extent as can be expected in a large manufacturing town. Obviously, the question of the internal ventilation of back-to-back houses in its sanitary aspects has very close relations with the quality of the air supplied to them from without.

"Assuming it to be true that back-to-back house construction is to a certain extent a necessity in Bradford, we must state that we are not prepared to say that their erection there is strictly limited within the bounds of the economic considerations which we are informed render that construction necessary. There is, no doubt, a strong local prejudice among the operative and other classes in favour of these houses, and we observed certain houses in course of erection which might almost be denominated back-to-back villas. These houses consisted of commodious four-roomed cottages, having the requirements of good through houses, built as back-to-back houses. It is not easy to understand how so curious a perversion in house-building is permitted by the Corporation."

Messrs. Netten Radcliffe and Gordon Smith further say "that the Bradford plan is defective in so far as the breaks in the rows are incomplete, the covered passages intervening between each block of four houses being a very imperfect provision for cross-ventilation, in our estimation, as compared with a complete ventilation. The extra bedroom gained in the Bradford plan is regarded as a set-off for the complete break. We cannot look upon it in this sense, especially in view of its being an inducement for families of larger size than desirable to occupy these houses. Moreover, the want of the complete break makes it necessary, on the Bradford plan, to group the privies in the face of the houses on one side of the row—an inconvenient and somewhat indecent practice, and one subjecting the adjacent houses unduly to the chances of privy nuisance."

Towards the close of their report the Inspectors state that one of the most important elements in the regulation of back-to-back house arrangement relates to the provision made for excrement disposal in connection with them, so as to maintain the purity of air around them. They point out that although this question is not peculiar to back-to-back houses, it has, for obvious reasons, for them a special importance; and recommend to the Local Government Board that where a Local Authority is permitted to have bye-laws for the regulation of back-to-back houses, the arrangement for excrement disposal should at the same time have serious consideration.

Such, then, was the state of affairs at the time when Messrs. Netten Radcliffe and Gordon Smith made their report; and as regards the building of back-to-back houses in "blocks of four", operations went on briskly up to June 1894, when, in consequence of the offensive character of the emanations emitted from privies or defective water-closets in some districts, the whole question of back-to-back house construction was raised, and a decision arrived at by which houses after the style of Plan No. 2 could be built, the plan showing that the land attached to each is situate wholly on one side, each house having its sanitary appurtenances in its own ground, and placed as far as possible from the building itself.

This reconsideration of the building bye-laws was partly influenced by the decision of Mr. Justice Wills and Mr. Justice Wright, sitting in the Queen's Bench Division, on 4th of December 1893. They dismissed an appeal in the case of Travis *v.* Utley, which dismissal decided that any drain carrying the sewage of any two or more houses

was a "sewer" within the meaning of the Public Health Act, and repairable by the local Sanitary Authority. This decision put upon the Sanitary Authority the responsibility of the maintenance of the drains from all back-to-back houses built in blocks of four, for in this method of house construction the waste water pipes from the kitchen or scullery unite in the passage before entering the street sewer. Obviously, the only way for Sanitary Authorities to avoid incurring further serious responsibility was to insist upon each house having its own drain taken separately into the street sewer.

But, in the meantime, some enterprising builders had erected a considerable number of through houses very much after the style shown in plan No. 1, and were delighted to find that applications from intending tenants were received as soon as the houses were certified to be fit for habitation. This class of house has now become very popular, and is chiefly inquired for by the best class of artizans.

It is now two years since the Corporation sanctioned any plans for houses on the back-to-back principle.

The causes, therefore, which have brought about the abolition of back-to-back house erection in Bradford and some neighbouring towns are chiefly these, viz.:—

1. The inconvenience experienced in the matter of excrement removal and disposal, there being no back street in connection with "block of four" system.

2. The increasing demand on the part of the working classes for through houses in preference to back-to-back houses.

3. The decision of Justices Wills and Wright in reference to drainage, by which the drainage of blocks of four is rendered an extremely difficult matter.

At the time of the Inquiry by Dr. Barry and Mr. Gordon Smith into the subject of back-to-back houses, very little knowledge as to the prevalence of sickness and disease in reference to them had been obtained; in fact, the only statistical evidence given upon this part of the Inquiry in their report was supplied by Dr. Tatham, and had reference to some of the more ancient and insanitary areas in the borough of Salford. Dr. Barry and Mr. Gordon Smith state that:—

"As regards this section of the Inquiry, we experienced great difficulty in obtaining any reliable information. We found in all the districts visited that there was a general opinion on the part of the Medical Officers of Health that

back-to-back houses, as compared with through-and-through houses, had an unfavourable influence on the health of the inhabitants, but we could not find that this opinion was supported by any ascertained facts; indeed, no systematic study appeared to have been made to determine by actual observation the influence which houses with and without through ventilation respectively have had upon health.

"From our own observations we are convinced that, as regards many of the Yorkshire towns, little difficulty would be experienced by the local Medical Officer of Health in ascertaining the relative incidence of pulmonary disease, phthisis, diarrhœa, and infectious disease generally in houses of the two classes, as in several of the towns there are more or less distinctly defined districts composed respectively of houses of these two classes."

Some three or four years after the publication of this report, the back-to-back house question was keenly discussed by members of municipal bodies and others who took an interest in house property and the housing of the working classes in the West Riding, the result being that a protracted controversy was carried on by means of the daily newspaper in the district.

At length the question was taken up by Dr. Bell, of Bradford, who made some inquiry into the general mortality amongst the inmates of the two classes of houses, and found that in this respect the through-and-through houses compared unfavourably with those built on the back-to-back plan.

Mr. Herbert Jones, Medical Officer of Health for Crewe, afterwards made an investigation into the death-rates in back-to-back as compared with those in through houses, in the districts of Shipley and Saltaire, and communicated his information to the Bradford Medico-Chirurgical Society on the 2nd of May 1893: he showed that the death-rates from all causes—from phthisis, respiratory diseases, zymotic diseases, and diarrhœa—were higher in the case of the back-to-back than the through houses. The districts selected by Mr. Jones for his inquiry were very favourable for such an investigation, and I attach great importance to his results.

The statistical work on this point done by Dr. Tatham and Dr. Niven, of Manchester, had reference to a large amount of house property which had become unhealthy by reason of its age and immediate surroundings, in addition to the fact of its containing a large proportion of houses of the back-to-back variety. This, I think, is shown by the

enormously high death-rates obtained in the districts investigated by these observers. Dr. Niven obtained death-rates from all causes varying between eighteen and forty-six per 1,000 of the population.

In selecting districts in Bradford for my inquiry, I have had considerable difficulty in obtaining those which in all respects would be strictly comparable. They are therefore small, but the houses comprised within them are as alike in age, in sanitary circumstances, and in the class of artizans who occupy them, as it is possible to obtain.

The two groups of back-to-back houses contain respectively 1,928 and 619 dwellings: the third group contains 751 through houses.

The population, as ascertained from the returns of the district enumerators employed in the census of 1891, is shown to be 9,116 for the first district, 2,728 for the second, and 4,002 for the third district. This gives an average of 4.7 and 4.4 persons per house for the two back-to-back groups, and 5.3 per house for the group of through houses. The average area per house, including the streets, is 125 square yards, and 98.6 square yards for the two groups of back-to-back houses, and 116.6 square yards for the through-house group. The average number of square yards for each occupant is only 22.0 for those living in the through houses, but 26.5 and 24.2 for persons inhabiting the back-to-back houses. Similarly, a greater density of population is shown for the through houses as compared with the back-to-backs, there being 219 persons per acre to the former, as compared with 181 and 215 for the latter.

—	Total No. of Houses.	Population.	Average No. of Persons to each House.	Average No. of Square Yards to each House.	Average No. of Square Yards to each Person.	No. of Houses per Acre.	No. of Persons per Acre.	Weekly Rental (including Rates).	Death rate per 1,000 during the Years 1890-91-92.		
									All Causes.	Phthisis.	Diarrhœa.
Back-to-Back in Blocks of four	1928	9116	4.7	125.0	26.5	38.7	181.89	5/3 6/-	18.3	1.68	.25
Back-to-Back in continuous rows.	619	2728	4.4	98.6	24.2	49.0	215.6	4/6 5/9	17.7	2.41	.00
Through Houses	751	4002	5.3	116.6	22.0	41.5	219.95	6/- 7/6	15.1	1.39	.39

In considering the mortality rates I have taken the

number of deaths occurring in the three districts for the years 1890, 1891, 1892, and have applied the population as ascertained at the 1891 census: a proceeding although not perhaps absolutely correct, yet containing an error so small as to be inappreciable.

The mean death-rate for the through-house district is 15.1 per 1,000 of the population, as compared with 17.7 and 18.3 per 1,000 for the other two districts. The mean death-rate from phthisis is 1.39 per 1,000 for the through houses, whilst that for the back-to-backs is 2.41 and 1.68 respectively; which figures, I think, show that although there is a greater density of population in the through houses, there is something which makes for a greater prevalence of phthisis in houses not provided with means for through ventilation. In reference to the diarrhœal diseases, the figures are so small that I do not attach much importance to them. I had an idea, obtained by inquiries from medical practitioners in Bradford, that in back-to-back houses diarrhœal diseases were more common in the rear houses which overlooked the privies than in those which fronted the street, but on examining the health reports of my predecessors I found the following paragraph in the report of the late Mr. Harris Butterfield for the year 1878:—

"During an epidemic of summer diarrhœa which prevailed in Bradford in 1878, 101 houses in which deaths had occurred were visited. Of the 101, ninety were of the back-to-back description, two were cellar dwellings, and nine through houses. Of the ninety back-to-back houses, sixty fronted the street, and thirty the back yards. Why the deaths should be twice as numerous in the front houses as in the back ones, which face the privies and ashpits common to both, is not easily accounted for, unless the more ready access to the conveniences induces a more frequent and prompt removal of the excreta than is the case in the front houses. I have frequently remarked that rather than pass through the portions of streets and passages necessary to reach the proper receptacle, women will conceal excreta in some obscure corner of the premises until nightfall. The effect of thus contaminating the already sufficiently close atmosphere of a back-to-back house is, of course, exceedingly prejudicial to a child suffering from the effects of bad nursing and improper diet. More especially is this the case when the obscure corner before mentioned is beneath the shelf on which the milk is kept."

A similar investigation of my own, however, showed that out of about the same number of cases in the year 1893, 57 per cent. occurred in the rear houses in comparison with 43 per cent. in the houses fronting the street. Nevertheless, I am quite sure that offensive material is kept in the front houses, as described by Mr. Butterfield, and is the direct cause of filth diseases that might easily be prevented.

For municipal and sanitary purposes the Borough of Bradford is divided into fifteen districts or wards, the populations of which, at the 1891 census, varied from 4,846 to 22,469. On dividing these wards into two groups: one of nine wards, containing over 60 per cent. of houses built on the back-to-back system, and another of six wards, containing less than 60 per cent. of back-to-back houses, I find the death-rates from all causes, from phthisis, and from diarrhœa, in them during the years 1890-91-92 per 1,000 of the population, were as follows:—

	All Causes.	Phthisis.	Diarrhœa.
Group I containing over 60 per cent. of Back-to-Back Houses) ...	23.7 ...	1.93 ...	.83
Group II (containing less than 60 per cent. of Back-to-Back Houses) ...	19.8 ...	1.71 ...	.36

PUERPERAL MORTALITY.

By W. WILLIAMS, M.A., M.D., and D.P.H.(Oxon.).

(*Read: March 20th*, 1896.)

I HAVE selected the subject of Puerperal Mortality as the title of my paper because:—

1. It is a dark, deep, and continuous stream of mortality, which has been running through our statistics since the commencement of registration — indeed, from the most remote periods—without showing any signs of abatement, and occasionally overflowing its banks, producing epidemics with most disastrous results.

2. It is a mortality which is, to a great extent, preventable, as evidenced in the enormous improvement which has of late years marked the records of our maternity institutions both at home and abroad.

3. It is a mortality which has been exceptionally high among women in Wales, in whose health and safety I am greatly interested; and with the mode of life, social relations, and personal conditions of many of whom I am fairly well acquainted.

4. It is high time that some serious attempt should be made by the Legislature, and all concerned, to put an end to such painful sacrifice of mothers.

I may tell you at the outset that I have nothing fresh to communicate, but I have marshalled, at some trouble, a formidable array of figures which cannot fail to convince the most callous that it is our duty to use all our endeavours to protect the mothers of England and Wales, about 4,000 of whom annually die in childbed.

Puerperal Mortality naturally divides itself into:—

(*a*) Deaths from Puerperal Fever.

(*b*) Deaths from what is termed "the accidents of childbirth."

To give a definition of puerperal fever is difficult, and had better not be attempted, since it is a subject of great controversy. For our present purposes it is enough to state that it is a fever peculiar to lying-in women, and

sufficiently definite to be distinguished from any other cause of childbed mortality.

"The accidents of childbirth" include such conditions as hæmorrhage, placenta prævia, puerperal mania, convulsions, and various others, often proving fatal *only* in the absence of skilled assistance.

The figures given in the Annual Reports of the Registrar-General from 1847 to 1894—a period of forty-eight years—are tabulated below, where the death-rate is based on the proportion of deaths to *registered births*, and not to the general population as in corresponding tables for other diseases, consequently miscarriages and stillbirths are not included. The rate, though not absolutely correct, is more so than any other based on an always variable population.

TABLE I.

Puerperal Mortality in England and Wales.

Year.	Deaths from Puerperal Fever per 1,000 Births.	Deaths from Accidents of Childbirth per 1,000 Births.	Year.	Deaths from Puerperal Fever per 1,000 Births.	Deaths from Accidents of Childbirth per 1,000 Births.
1847	1.5	4.5	1871	1.8	3.1
48	2.4	3.9	72	1.7	2.9
49	2.0	3.9	73	2.1	2.8
1850	1.9	3.8	74	3.6	3.3
51	1.6	3.5	75	2.9	2.8
52	1.6	3.6	76	2.0	2.7
53	1.3	3.7	77	1.6	2.2
54	1.7	3.2	78	1.6	2.1
55	1.7	2.9	79	1.7	2.1
56	1.6	2.8	1880	1.9	2.0
57	1.3	2.9	81	2.6	2.2
58	1.6	3.1	82	2.9	2.2
59	1.8	3.2	83	2.9	2.1
1860	1.4	3.2	84	2.7	2.0
61	1.3	3.0	85	2.7	2.2
62	1.3	2.9	86	2.3	1.9
63	1.6	3.3	87	2.8	1.9
64	2.0	3.4	88	2.7	2.0
65	1.8	3.3	89	2.1	1.9
66	1.5	3.2	1890	2.2	2.6
67	1.4	3.0	91	2.2	3.0
68	1.5	2.9	92	2.6	3.1
69	1.5	2.8	93	3.3	3.2
1870	1.9	3.0	1894	2.4	2.3
Total				96.3	137.6
Mean				2.0	2.9

This table shows that puerperal fever attained its maxi-

mum recorded mortality during registration times in 1874 (3.6); the year 1893 comes next with (3.3); the mortality from the "accidents of childbirth" varied from the highest in 1847 (4.5) to the lowest in 1886, 1887, and 1889 (1.9). The mean annual mortality rate for the former was (2.0), and for the latter (2.9) per 1,000 registered births.

It will be remembered that the year 1893 was exceptionally dry, that the mortality from typhoid fever and diarrhœa was higher than in any previous year since 1884, and that the mortality from diphtheria was the highest on record.

Immediately before 1874, puerperal fever death-rate was not particularly high, but from 1881 to 1894—a period of fourteen years—there has been a higher sustained mortality than in any other previous and corresponding period. During the period in question it was lowest in 1889 and highest in 1893, the years immediately preceding and following the most severe outbreaks of influenza.

The Registrar-General in his 38th Annual Report writes:—"The mortality of the mothers of England, notwithstanding the progress of obstetrical art, was higher in 1874-5 than it has ever been since 1847." It was about 1874, in consequence of the Public Health Act of 1872, that it became incumbent upon local authorities in all parts of England and Wales, outside the Metropolis, to appoint medical officers of health, and it was then that the greater number of rural districts at least came under medical supervision. From 1885 to 1894 the death-rate from puerperal fever was (2.5), and higher than in any other decenniad since the commencement of registration. This is most surprising, inasmuch as the period in question coincides with one of great sanitary improvement and activity; and this, notwithstanding the practice, which was commenced by the Registrar-General for the first time in 1881, of sending out letters of enquiries to all practitioners who had used the terms, "peritonitis, pyæmia, septicæmia, etc.," in registering the deaths of women of the child-bearing age. It is certain that such a practice has led to a greater inclusion under the heading of "puerperal fever" of a number of deaths that would otherwise not have been classified as such, and doubtless the increased mortality from this cause is more apparent than real. This period of improved certification and sanitation has now extended for fifteen years, and has not a sufficient time elapsed within which we might have reasonably expected a decline in this mortality?

In consequence of improved hygienic conditions and the introduction of antiseptics, a great reduction of mortality has occurred in the case of lying-in hospitals at home and abroad. Judging from the enormous improvement which has of late years marked the records of these institutions, from which puerperal fever has almost disappeared, but which in their earlier days were prolific centres of the disease, and almost defeated the ends for which they were established, puerperal fever is a markedly preventable disease. We certainly have had improved sanitation *generally*, but a decline in the mortality from puerperal fever is conspicuous by its absence in general practice. Therefore, this sustained mortality is due to the prevalence of the malady *outside* maternity hospitals; and it follows that the conditions under which women are confined outside these institutions have not shared in an equal degree the improvements effected inside them; and that we cannot expect reform to result from improved sanitation *alone*, but must take into consideration other important factors.

A condensed statistical information for the 48 years (1847—1894), four decenniads, and one period of eight years, is given below.

		Puerperal Fever.		Accidents of Childbirth.
1847–54	...	1.72	...	3.01
1855–64	...	1.56	...	3.07
1865–74	...	1.78	...	3.03
1875–84	...	2.28	...	2.24
1885–94	...	2.53	...	2.41

The rate of mortality from the former has steadily increased from 1855 to 1894, whereas the mortality for the latter, which was fairly constant from 1847 to 1874, has since decreased.

Mortality at different Ages.

Deaths in childbirth happen in many ways, and different causes operate with variable force at different periods.

It has been estimated that the number of women at different ages bearing children are as follows:—From 15 to 25 only one in 16 bears a child in the year, and at 45 and upwards the proportion is inconsiderable; while at the age of 25 to 35, one in every four women bears a child in the year, and at 35 to 45 the proportion is one in six. Therefore the age 25 to 35 represents the period of life in which British women bear the greatest number of children, and it is calculated that the mortality of women at that age from all causes is nearly one per cent.

The following Tables will serve to throw some light on the age-distribution of this mortality. None are obtainable for later years.

TABLE II.

1855-56 (*Two Years*).

Age.	Estimated Number of Women bearing Children.	Deaths from Puerperal Fever.	Annual Rate of Mortality from Puerperal Fever per 1,000 Mothers bearing Children.
15-25	107,440	609	2.69
25-35	328,720	942	1.36
35-45	166,140	565	1.62
45-55	7,545	27	1.72
15-55	609,845	2,146	1.67

TABLE III.

1855-57 (*Three Years*).

Age.	Estimated Number of Women bearing Children.	Deaths from Puerperal Fever.	Annual Rate of Mortality from Puerperal Fever per 1,000 Mothers bearing Children.
15-25	107,440	841	2.46
25-35	308,720	1,302	1.24
35-45	166,140	797	1.51
45-55	7,545	42	1.71
15-55	609,845	2,982	1.54

TABLE IV.

1855-58 (*Four Years*).

Age.	Estimated Number of Women bearing Children.	Deaths from Puerperal Fever.	Annual Rate of Mortality from Puerperal Fever per 1,000 Mothers bearing Children.
15-25	107,440	1,146	2.50
25-35	328,720	4,177	1.27
35-45	166,140	1,078	1.52
45-55	7,545	49	1.52
15-55	609,845	4,050	4.55

TABLE V.

1848-54 (*Seven Years*).

Age.	Estimated Number of Women bearing Children. (1851.)	Deaths from Puerperal Fever.	Deaths from Accidents of Childbirth.	Annual Rate of Mortality from Puerperal Fever per 1,000 Mothers bearing Children.	Annual Rate of Mortality from Accidents of Childbirth per 1,000 Mothers bearing Children.
15-25	107,440	2,085	2,940	2.77	3.91
25-35	328,720	3,401	6,378	1.48	2.77
35-45	166,140	1,791	5,568	1.54	4.79
45-55	7,545	86	380	1.63	7.20
15-55	609,845	7,363	15,266	1.73	3.58

TABLE VI.

1855-67 (*Thirteen Years*).

Age.	Estimated Number of Women bearing Children. (1861.)	Deaths from Puerperal Fever.	Deaths from Accidents of Childbirth.	Annual Rate of Mortality from Puerperal Fever per 1,000 Mothers bearing Children.	Annual Rate of Mortality from Accidents of Childbirth per 1,000 Mothers bearing Children.
15-25	116,474	4,023	5,731	2.66	3.78
25-35	368,487	6,624	11,880	1.38	2.48
35-45	192,979	3,533	10,493	1.41	4.18
45-55	8,623	156	604	1.39	5.39
15-55	686,563	14,336	28.708	1.61	3.22

The Tables given represent periods of two, three, four, eight and thirteen years respectively. Taking Tables V and VI, the mortality of childbearing women at different ages during the seven years (1848 to 1854), and the thirteen years 1856-67, is given. During the former period 5.31, and during the latter period 4.83 women in 1,000 delivered, died. At the earlier age (15-25) the mortality was six or seven in a 1,000; at the latter age (35-45) it was six; and at the extreme age (45-55), it ranged up to seven or nine.

From puerperal fever the mortality is twice as high at the earlier age, 15-25, as it is at the subsequent age-periods; thus the rate is then 2.66, and afterwards 1.38 in the thirteen years 1855-67. The mortality from accidents of childbirth is lowest at 25-35, but afterwards it increases rapidly as age advances. The mortality from all causes is highest from 15-25, and lowest from 25-35, but it afterwards rapidly increases as age advances.

The higher mortality from puerperal fever in early life can scarcely be explained without taking into account recurrence in zymotic disease. Few recover from severe attacks of puerperal fever, and it may be that those who have recovered from slight attacks become to some extent exempt for the future. There are cases in which puerperal fever has occurred twice, or rather what is called puerperal fever, but I have been unable to find any records of them. Of course we know that most of the septic fevers are much more fatal during the early periods of life than in later years; this applies not only to man but also to animals, so that the above statements are quite in accordance with actual experiment.

As to whether a woman who has recovered from puerperal fever is *more* or *less* liable to a second attack, the opinions of eminent obstetricians differ greatly. A friend of mine tells me that one attack of puerperal peritonitis (that is the word he uses, not "fever") does not in any sense confer a certain immunity against a second attack after a subsequent pregnancy, but rather the contrary: for in several cases in which a patient has passed through a severe attack of peritonitis after one confinement, the succeeding puerperia are complicated by severe attacks of pelvic inflammation.

That puerperal fever is more liable to attack and prove fatal in the case of *primiparæ* than in *multiparæ* is almost certain, and may perhaps be explained on the ground of their greater liability to tears and lacerations, thus opening up an extra channel to infection. In the case of an epidemic which I investigated, I noticed that out of 12 cases in which *primiparæ* were attacked, eight, or 75 per cent., ended fatally; while out of the fourteen cases where *multiparæ* were attacked, four, or 28.6 per cent., ended fatally.

Mortality in the Registration Counties.

The following lengthy Table (No. VII) shows the mortality in each of the registration counties of England and Wales. I have thought it wise to deal with each county upon its own merits, and I now propose to consider this Table first for the period of 47 years (1848-1894) which it covers, and afterwards more in detail for a period of ten years, 1885-94, in the case of Welsh counties only. By 1894 the effect of the better certification ought to have made itself felt, but before 1881 it is certain that many puerperal deaths escaped registration as such. In support of this statement I quote

YEAR.	LONDON.						MIDDLESEX.				R		E
	LONDON.												
	A	B	C	D	E	A	B	C	D		B	B	
1848	71380	321	251	4.5	3.5	547	12	21	3.1	4	3639	3	3.
1849	72612	256	248	3.5	3.4	556	4	18	0.9	9	1541	1	4.
1850	74564	197	244	2.7	3.3	574	11	18	2.4	1	2670	2	3.
1851	78300	131	292	1.9	3.7	597	9	19	2.0	8	1448	1	3.
1852	81250	132	319	1.6	3.8	613	7	9	1.5	2	1598	1	5
1853	82254	100	300	1.2	3.6	621	4	11	0.9	5	925	0	3
1854	84885	168	260	1.9	3.0	636	3	11	0.6	6	1046	2	2
1855	85532	211	264	2.4	3.0	634	4	9	0.8	0	1811	2	2
1856	87430	183	229	2.1	2.7	693	8	10	1.5	2	2136	1	2
1857	89577	118	247	1.3	2.7	707	10	12	1.9	3	846	0	1
1858	89012	171	252	1.9	2.9	733	7	13	1.3	4	1849	2	1
1859	92909	211	256	2.1	2.5	80[illegible]	11	15	1.9	7	2531	0	1
1860	93414	151	244	1.6	2.6	80[illegible]	5	10	0.9	9	778	0	1
1861	97064	162	234	1.7	2.4	84[illegible]	8	17	1.4	5	809	0	1
1862	97850	190	245	1.9	2.5	86[illegible]	13	15	2.2	0	1015	1	1
1863	102119	220	237	2.1	3.2	90[illegible]	8	16	1.2	9	2336	2	1
1864	102625	287	308	2.8	3.0	93[illegible]	14	23	2.1	3	1432	1	1
1865	106803	200	318	1.9	3.0	97[illegible]	12	16	1.7	0	2549	2	1
1866	108665	179	325	1.6	2.9	101[illegible]	7	23	0.9	2	2210	1	1
1867	112691	168	290	1.4	2.5	105[illegible]	9	21	1.1	2	2334	2	1
1868	113937	224	251	1.9	2.2	115[illegible]	12	21	1.4	2	3382	0	1
1869	112332	213	247	1.8	2.2	116[illegible]	12	19	1.4	0	1416	2	1
1870	113902	278	283	2.4	2.5	118[illegible]	9	24	1.0	8	2286	2	1
1871	112617	221	337	1.9	2.9	118[illegible]	13	17	1.5	1	5224	0	1
1872	118440	255	261	2.1	2.2	122[illegible]	14	20	1.5	4	3396	1	1
1873	119015	333	282	2.9	2.4	120[illegible]	18	16	1.9	3	3406	0	1
1874	12[illegible]950	483	318	4.0	2.6	122[illegible]	32	28	3.4	5	3967	1	1
1875	123266	293	288	2.4	2.3	123[illegible]	33	12	3.4	3	4219	0	1
1876	112744	264	321	2.1	2.5	130[illegible]	15	30	1.4	9	3614	1	1
1877	128092	221	224	1.7	1.7	130[illegible]	15	14	1.4	7	3812	1	1
1878	129769	195	188	1.5	1.4	133[illegible]	25	22	2.3	7	3744	0	1
1879	13542	195	177	1.5	1.3	135[illegible]	22	20	1.9	7	3947	1	1
1880	133310	261	191	1.9	1.4	139[illegible]	15	21	1.2	8	4292	1	1
1881	132904	390	207	2.9	1.5	141[illegible]	25	29	2.0	2	4175	2	1
1882	133311	333	237	2.5	1.7	147[illegible]	36	28	2.6	7	4545	2	1
1883	134503	364	203	2.7	1.5	146[illegible]	52	30	3.6	2	4224	1	1
1884	135651	341	211	2.5	1.5	146[illegible]	36	17	2.4	1	3218	0	1
1885	132952	340	212	2.5	1.5	147[illegible]	40	22	2.6	4	4083	1	1
1886	134339	289	206	2.1	1.5	149[illegible]	28	21	1.7	9	3234	1	1
1887	133359	355	156	2.6	1.1	147[illegible]	43	30	2.7	3	4515	1	1
1888	133761	291	202	2.2	1.5	147[illegible]	43	21	2.8	9	4466	0	1
1889	132233	244	178	1.8	1.3	149[illegible]	37	17	2.2	3	4919	1	1
1890	128161	249	238	1.9	1.8	145[illegible]	31	33	1.9	4	6044	0	1
1891	134484	216	347	1.6	2.6	152[illegible]	35	35	1.9	7	6038	0	1
1892	132328	347	307	2.6	2.3	149[illegible]	37	51	2.1	8	6436	3	1
1893	133062	394	332	2.9	2.5	151[illegible]	62	42	3.4	7	6372	0	1
1894	131454	238	266	1.8	2.0	149[illegible]	36	36	2.0				
Total.	—	11583	12133	102.8	112.1	—	943	983	929	1			
Mean Annual Rate for 47 Years.	—	—	—	2.1	2.4	—	—	—	1.9				
Mean Annual Rate for last 10 years.	—	—	—	2.2	1.8	—	—	—	2.3				

Births.

Births.

| R | | |

the words of the Registrar-General in his 47th Annual Report :—

"Out of 453 cases of married women whose deaths were returned in 1884 simply as due to 'peritonitis' or 'septicæmia,' it was found on inquiry that no less than 156 were cases of a puerperal character." So we may rightly assume that the figures given after 1884 are nearer the truth than any that appeared before.

An analysis of Table VII shows that the death-rate per 1,000 registered births from puerperal fever ranged from 2.4 to 1.0 in the various counties, thus :—Lancashire (2.4); North Wales, South Wales, Northumberland, Cheshire (2.2); Cumberland, Durham, W. Riding, Derby and London (2.1); Salop, Stafford, Monmouth, and England and Wales (2.0); Worcester, Norfolk and Middlesex (1.9) N. Riding, Notts, Gloucester, Wilts, Bedford, Northants and Herts (1.8); E. Riding, Westmorland, Leicester, Warwick, Hereford, Berks, and Hants (1.7); Somerset, Devon, Oxford, Kent (1.6); Lincoln, Suffolk, Essex, Cambridge and Bucks (1.5); Rutland, Dorset, Hunts, Sussex, (1.3); Cornwall (1.2); and Surrey (1.0).

So that Lancashire heads the list with 2·4, and is closely followed by North Wales, South Wales, Northumberland, Cheshire, Cumberland, Durham, West Riding, Derby, and London (all above the mean for England and Wales, 2.0): Surrey has the lowest, and close to it comes Cornwall, Sussex, Hants, Dorset and Rutland (all under 1.4). That there is a marked difference in the various rates is obvious, but we are not justified at this stage in drawing any conclusions from the figures before us, for even the circumstances which obtain in various localities only a few miles apart in the same county are so vastly different, as I hope to show you presently. However, as a general rule it would seem that the rate was highest in the west counties, especially in the hilly Welsh division; or, roughly, in those counties and parts of counties west of a straight line drawn from the mouth of the Severn to that of the Tees.

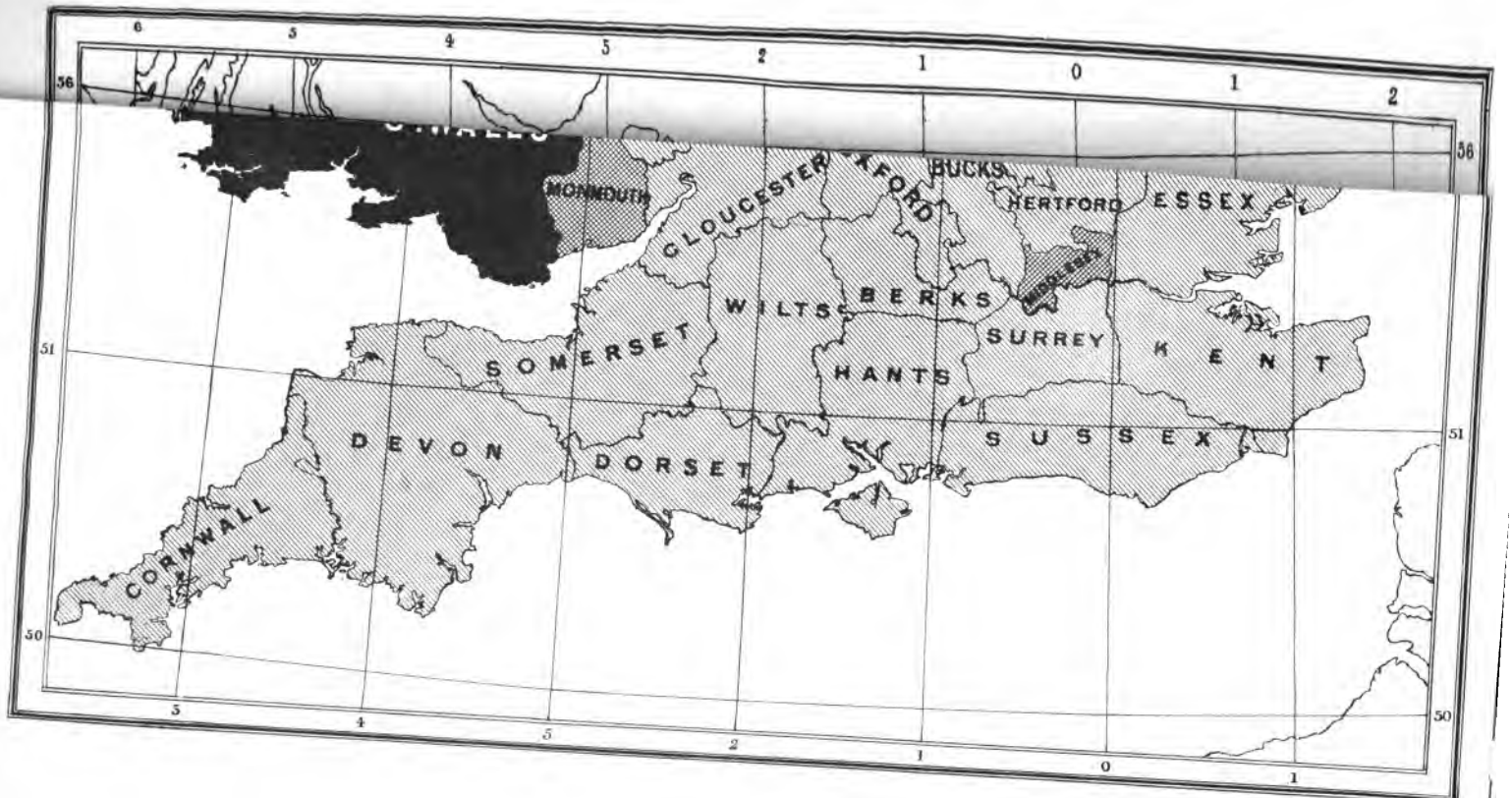
The death-rate from "accidents of childbirth" ranges from 4.1 to 1.9 per 1,000 registered births, thus:—North Wales (4.1), South Wales (3.7), Monmouth (3.6), Hereford (3.4), Cheshire and Salop (3.2), Lancashire, Derby, Cornwall and Wilts (3.1), North Riding (3.0), Cumberland, Northumberland, Durham, Oxford, and Bucks, and England and Wales (2.9), West Riding, Gloucester, Somerset, Dorset, Norfolk, Berks, and Surrey (2.8), East Riding, Lincoln, Worcester, Bedford, Herts and Middlesex (2.7), Westmore-

land, Notts, Stafford, Devon, Northants and Sussex (2.6), Warwick and Suffolk (2.5), Cambridge, Hants, Kent and London (2.4), Leicester, Essex and Hunts (2.3), Rutland (1.9).

Here a much wider difference between the two extremes is observed, and the death-rate is above the mean in the hilly counties of the Welsh division and in the border counties of Hereford, Cheshire and Salop; or, roughly, west of a straight line drawn from the mouth of the Severn to the mouth of the Mersey. It is below the average in Leicester, Essex, Hants and Rutland.

So far our figures show that the mortality from puerperal fever is much more evenly distributed than that from accidents of childbirth. Both rates are similar, in that they are highest in the Welsh division. I have shown that puerperal mortality has varied during the forty-seven years in question within wide limits in the different counties of England and Wales, and that it has been markedly high in Wales. Here it should be observed that the conditions of life might have completely changed in the time. This has actually occurred in several instances. Glamorgan is a typical example of a county where the conditions of life in many of its to-day thickly populated coal-mining valleys were, thirty to forty years ago or less, those of a purely agricultural and sparse population. There are also others; and, in order to make this inquiry complete, it would be necessary to go into this question for each individual county. This I cannot undertake on the present occasion, except in the case of the Welsh counties.

Having a fair knowledge of the general and local features of the separate counties of Wales, and especially with the circumstances under which women of the poorer classes are confined, I propose to give the figures for the individual counties, and further to deal in detail with the various registration districts and large towns in the county of Glamorgan, with a view of throwing some light, if possible, on the conditions of female life and other circumstances which determine these differences.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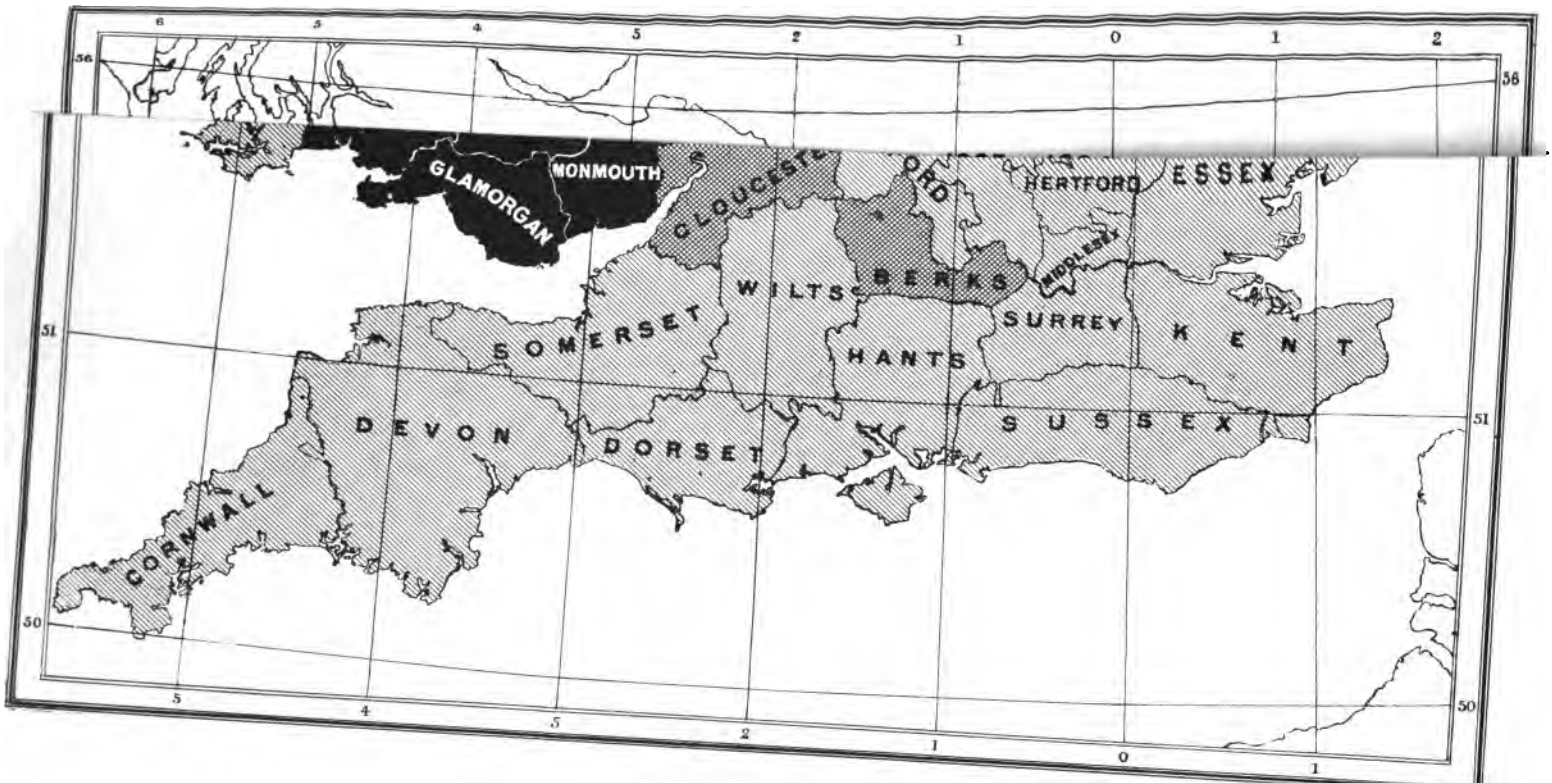
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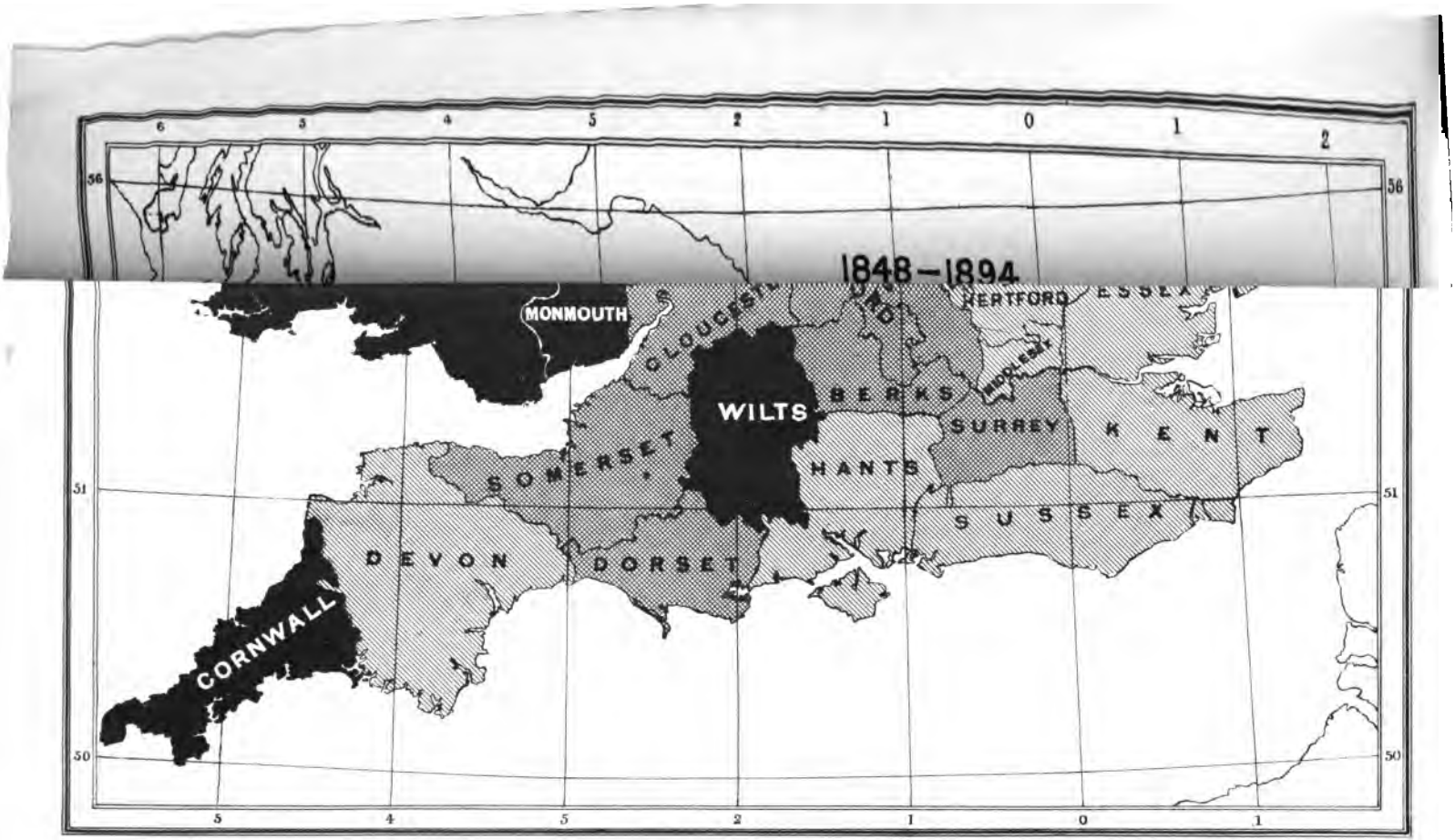
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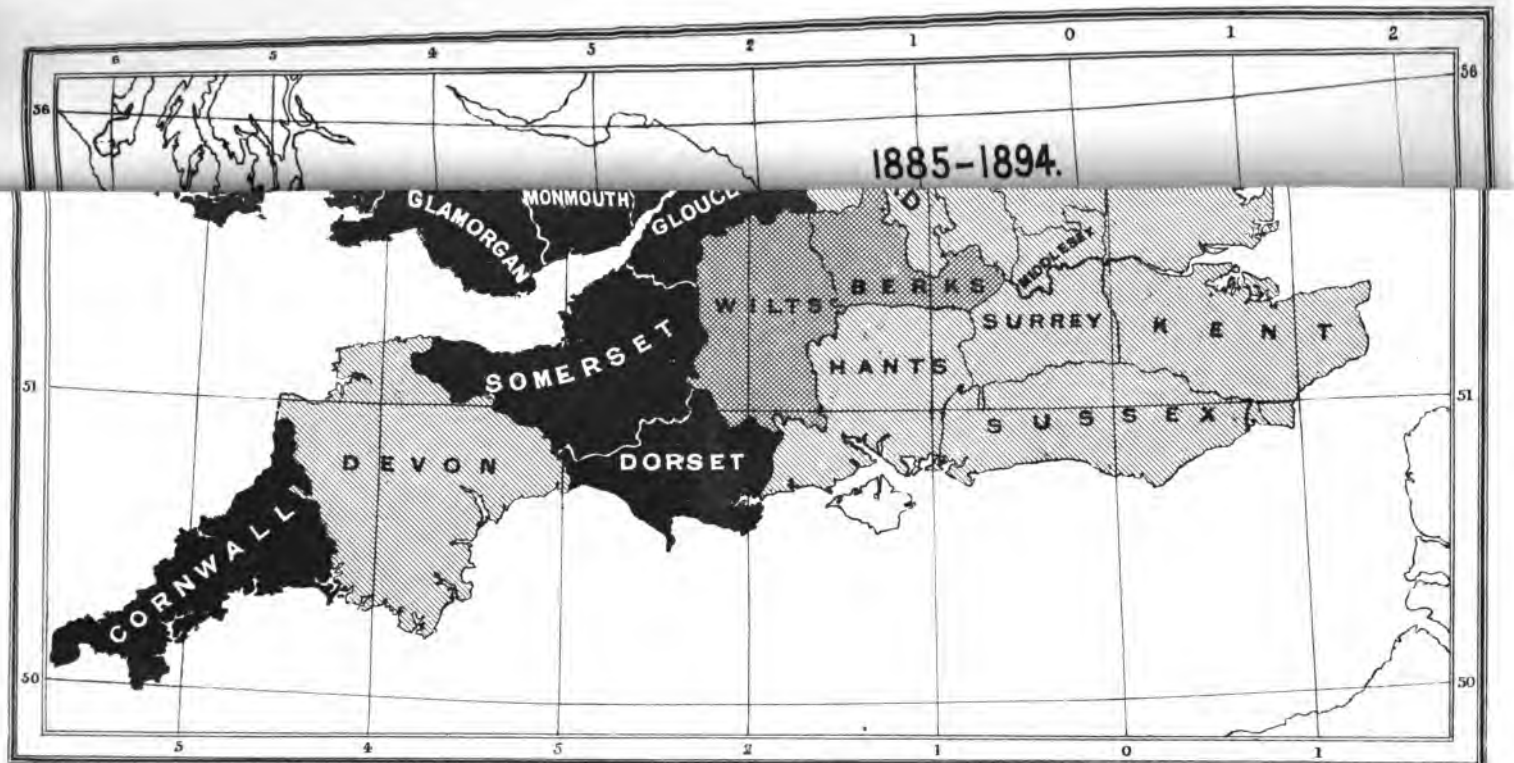
1885-1894.
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Wales.

The position of North Wales and South Wales, as compared with that of England and Wales from 1885 to 1894, will be learnt from the following tables :—

TABLE VIII.

—	47 YEARS (1848—1894).			10 YEARS (1885—1894).		
	Puerperal Fever.	Accidents of Child-birth.	Childbed (all causes).	Puerperal Fever.	Accidents of Child-birth.	Childbed (all causes).
North Wales...	2.2	4.1	6.3	3.2	3.8	7.0
South Wales...	2.2	3.7	5.9	3.3	3.3	6.6
England and Wales ...	2.0	2.9	4.9	2.5	2.4	4.9

or

TABLE IX.

The comparative number of Mothers Dying in Childbed for Periods of 47 and 10 Years respectively.

—	47 YEARS (1848—1894).			10 YEARS (1885—1894).		
	Puerperal Fever.	Accidents of Child-birth.	Childbed (all causes).	Puerperal Fever.	Accidents of Child-birth.	Childbed (all causes).
	1 in	1 in	1 in	1 in	1 in	1 in
North Wales...	454	243	159	312	210	142
South Wales...	454	270	169	298	302	151
England and Wales ...	500	345	204	395	414	204

That is to say, the puerperal mortality has been considerably higher in North and South Wales than in England and Wales during the decenniad 1885-1894. During this period the number of mothers lost was 3,234, 1,587 from puerperal fever and 1,647 from accidents of childbirth, *i.e.*, 323 annually, or 158 from the former and 164 from the latter.

The Table that follows gives statistical information for each individual Welsh county for ten years (1885 to 1894), the latest obtainable :—

TABLE X.

YEAR.	NORTH WALES.											
	Montgomery-shire.		Flint-shire.		Denbigh-shire.		Merioneth-shire.		Carnarvon-shire.		Anglesea.	
	A	B	A	B	A	B	A	B	A	B	A	B
1885	4.5	3.0	1.1	0.6	5.0	3.6	5.9	0.5	4.8	5.1	2.1	4.2
86	0.5	3.5	4.2	2.5	2.7	3.6	3.7	4.2	1.8	3.6	2.1	1.0
87	1.0	2.6	1.6	0.8	2.1	3.4	6.3	1.6	4.3	1.8	3.2	2.1
88	3.1	2.6	3.3	4.1	8.0	3.0	6.1	2.8	3.6	1.8	0.0	2.3
89	1.0	2.1	2.5	1.7	2.5	4.1	2.2	4.4	1.9	2.9	0.0	2.2
1890	1.7	5.3	1.7	2.6	3.6	7.0	2.9	5.2	3.9	6.9	3.7	2.5
91	1.1	2.2	2.4	4.8	2.0	6.0	4.3	6.7	3.1	4.0	3.3	6.6
92	1.8	5.9	0.8	5.7	2.6	5.3	4.2	5.4	1.9	4.2	3.5	3.5
93	2.7	3.2	4.7	0.7	3.2	4.6	4.0	4.5	3.4	3.4	3.2	2.1
94	4.9	4.9	3.1	3.9	3.9	6.2	5.3	4.7	4.9	4.0	2.4	1.2

TABLE X.—*continued.*

YEAR.	SOUTH WALES.											
	Glamorgan-shire.		Carmarthen-shire.		Pembroke-shire.		Cardigan-shire.		Brecknock-shire.		Radnor-shire.	
	A	B	A	B	A	B	A	B	A	B	A	B
1885	3.2	3.5	1.9	4.4	1.5	4.5	3.4	2.9	2.4	3.0	1.9	3.8
86	3.5	2.8	3.5	2.1	3.5	2.0	4.3	3.9	1.2	1.2	3.8	1.9
87	3.3	2.4	4.3	3.4	3.3	2.6	6.6	1.3	5.6	3.7	9.8	0.0
88	3.8	2.4	3.9	1.9	0.8	1.6	2.6	1.3	4.4	5.1	1.9	3.8
89	2.1	3.1	3.1	2.9	1.2	2.1	4.9	2.2	1.3	2.6	2.1	2.1
1890	3.1	3.4	3.1	2.5	0.8	3.0	1.4	5.3	3.2	3.9	0.0	6.6
91	4.1	3.9	1.9	1.3	3.0	3.4	2.9	7.9	1.9	6.3	0.0	0.0
92	3.7	4.3	3.3	2.4	1.7	3.9	3.3	3.3	3.9	4.5	4.6	4.6
93	4.8	3.9	5.9	4.3	5.0	2.5	8.9	4.6	1.2	3.6	0.0	10.5
94	2.3	3.7	3.8	2.7	0.9	3.1	4.4	3.4	2.6	4.6	0.0	6.9

A = Deaths from puerperal fever per 1,000 births.
B = Deaths from accidents of childbirth per 1,000 births.

It follows, therefore, that the death-rate from puerperal fever is above the mean for England and Wales in seven counties, and below the mean in four counties. With respect to accidents of childbirth, the death-rate is above the mean in eight and below in three.

The puerperal fever-rate is excessively high in Merioneth and Cardigan, two typical instances of purely agricultural and hilly counties containing a few old-fashioned towns and seaside resorts. It is lowest in Pembroke, Mont-

gomery, Anglesea and Radnor, purely agricultural but comparatively flat; whereas the mining county of Glamorgan and the scattered mining and agricultural counties of Carmarthen and Carnarvon come between.

Arranging the counties in the order of their death-rates, those with the highest coming first, we get :—

	Puerperal Fever.		Accidents of Childbirth.
Merioneth, Cardigan	4.4	Denbigh	4.7
Denbigh	3.6	Radnor, Merioneth	4.0
Carmarthen	3.5	Cardigan, Carnarvon	3.7
Carnarvon, Glamorgan	3.4	Montgomery	3.5
Brecknock	2.8	Brecknock	3.4
Flint	2.5	Glamorgan	3.3
Radnor, Anglesea	2.4	Pembroke	2.9
Montgomery	2.3	Carmarthen, Anglesea	2.8
Pembroke	2.2	Flint	2.7
Mean for Wales	3.2	Mean for Wales	3.5
,, England and Wales	2.5	,, England and Wales	2.9

The rate from accidents of childbirth was highest in Denbigh, Radnor and Merioneth (purely agricultural), and lowest in Carmarthen and Pembroke. Glamorgan and Carmarthen (the former a mining and the latter a mixed mining and agricultural county) are low in the list, the former slightly above and the latter slightly below the average for England and Wales.

In the following Table the Welsh counties are arranged according to density of population :—

	Density of Population (Acres to a Person).	Comparative Increase or Decrease per cent.
Glamorgan	0.8	+34
Flintshire	1.7	— 7
Carnarvonshire	2.5	+ 1
Denbighshire	3.3	+ 3
Anglesea	3.9	— 3
Carmarthen	4.0	+ 7
Pembroke	4.3	— 2
Cardigan	6.9	— 9
Merioneth	8.1	— 5
Montgomery	8.7	—12
Brecknock	8.9	— 2
Radnorshire	20.2	— 8
England and Wales	1.3	+12

Glamorgan is the only county that may be called

"densely populated", *i.e.*, with less than one acre to a person. Flint has less than two acres, while the remainder may be termed "sparsely populated".

From a consideration of the above figures, it does not seem that density of population is a factor of much importance in determining puerperal mortality; on the contrary, both the mortality from puerperal fever and accidents of childbirth display a marked tendency to prevail in those counties where the only features in common between them is that they are mountainous, hilly and sparsely populated, and that consequently locomotion is tedious and medical assistance difficult to obtain in time. On the other hand, the mortality seems to be generally lowest in the flatter counties.

I would now direct your attention to the

Registration County of Glamorgan,

which has an estimated population of some 800,000, over half the population of Wales. It covers 516,966 statute acres, and includes the two county boroughs of Cardiff and Swansea. The increase in its population has been phenomenal; thus, in

1801	it was	70,879	1851	it was	231,849
1811	„	85,069	1861	„	317,752
1821	„	120,073	1871	„	397,157
1831	„	126,612	1881	„	511,433
1841	„	171,188	1891	„	687,218

The county is divided by nature into a northern hilly country, "the Hills," cold, wet and sterile; and a southern low-lying country, "the vale of Glamorgan or the Garden of Wales," milder in climate and more fertile. The former is severed from the latter by steep slopes, where the coal measures crop out on the south of the mineral basin. The hills are mining districts, while the lower grounds, or the Vale of Glamorgan and Gower, are purely agricultural and sparsely populated. The surface of the coalfields may be looked upon as a great plateau with an elevation of 600 to 1200 or more feet above the sea level, and intersected by a series of more or less parallel valleys excavated to a depth of 500 to 800 feet below its general level, and at the bottom of which run rapid streams. The valleys in the eastern region—the Rhymney, the Taff, and their tributaries, the Rhonddas and Cynon—trend as a general rule towards the south-east; those of the middle—the Ely, Ogmore, Garw and Llynvi—to the south; while those of

the western region—the Avon, Neath, Tawe, and Loughor —trend towards the south-west. They are generally narrow and deep, opening upon the "Vale" or the Bristol Channel, and they offer great facilities for mining and the carrying away of minerals along the railroads and canals which are constructed along most of them. All the coal mines are in the hills and their valleys, where I shall show that puerperal mortality is exceptionally high.

Year.	Registration Districts.															
	Cardiff.		Ponty-pridd.		Merthyr Tydvil.		Bridgend.		Neath.		Pontar-dawe.		Swansea.		Gower.	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
1885	1.9	4.0	4.4	3.7	4.7	3.1	2.6	3.3	1.6	5.2	2.8	2.8	2.5	2.5	3.2	3.2
86	2.2	3.3	4.1	3.1	5.9	3.0	2.7	0.7	3.5	2.5	1.4	1.4	2.5	2.2	9.6	3.2
87	1.8	2.2	5.0	3.9	4.6	1.6	0.7	4.1	3.9	0.5	0.0	1.4	1.0	2.0	6.3	3.1
88	2.3	1.4	4.6	2.7	5.4	3.5	8.8	3.3	0.5	2.1	2.9	4.3	4.0	2.4	7.4	0.0
89	1.6	3.0	2.0	3.3	2.7	2.9	3.2	2.0	1.1	2.1	0.0	4.5	2.9	3.6	3.1	0.0
1890	1.7	3.0	4.1	3.8	1.7	4.6	5.4	3.0	3.1	3.6	2.6	2.6	3.9	2.8	8.9	0.0
91	1.8	3.3	5.1	5.4	6.4	4.3	4.3	4.9	4.6	2 9	1.3	4.1	3.7	2.9	0.0	3.2
92	2.7	4.1	3.5	5.4	4.7	4.8	8.0	3.1	4.2	2.9	2.4	7.2	4.0	3.9	0.0	3.1
93	3.3	3.2	5.0	5.2	7.7	2.9	6.5	2.0	5.6	5.6	2.2	12.2	3.3	2.6	0.0	0.0
94	1.6	2.4	3.3	4.2	4.1	4.3	3.3	2.7	0.0	5.1	1.1	4.6	2.5	3.8	0.0	7.5
Mean Annual Rates.	2.0	2.9	4.1	4.0	4.7	3.5	4.5	2.9	2.8	3.2	1.6	4.5	3.0	2.8	3.8	2.3

A=Deaths from puerperal fever, per 1,000 births.
B=Deaths from accidents of childbirth, per 1,000 births.

Although some 140,000 of the population live in what are termed rural districts, it is not more than 25,000 to 30,000 that live under true rural circumstances, and these are the people of Gower, of the Vale of Glamorgan, and of the Neath and Pontardawe districts partly. I have no separate figures for the Vale of Glamorgan, which includes portions of several sanitary districts, mixed industrial and agricultural.

Cardiff Registration District (0.4 acres to a person) includes the borough of Cardiff (160,000), Penarth (14,000), and Barry (20,000) urban districts, and a scattered industrial and agricultural district (20,000). Its sanitary condition is satisfactory, and confinements are attended generally by the medical men and trained midwives. Puerperal mortality exactly corresponds with the mean for England and Wales.

Pontypridd Registration District (0.5 acres to a person) includes two densely populated mining and urban districts,

Pontypridd (35,000) and Ystradyfodwg (112,000), also a scattered mining district (12,000). The sanitary condition is generally unsatisfactory. Puerperal mortality is excessive, and most of the confinements attended by untrained midwives.

Merthyr Tydvil Registration District (0.6 acres to a person) includes the large urban and mining population of Merthyr (65,000), Mountain Ash (20,000), and Aberdare (42,000), together with a scattered mining rural district (15,000). The sanitary condition of Merthyr Urban District is highly unsatisfactory, that of the remaining districts fair. The greater number of confinements are attended by midwives, of whom only a few, if any, are trained. Puerperal fever is always prevalent at Merthyr, and often epidemic. The death-rate from accidents of childbirth is slightly above the average.

Bridgend Registration District (2.1 acres to a person) includes the small town of Bridgend (5,000) and the four mining valleys of Garw, Ogmore, Gilfach and Maesteg (30,000), together with a small seaside resort (2,000), and an extensive rural district with an agricultural and mining population. In the Garw and Ogmore valleys there occurred an epidemic of this malady in 1892 and 1893; to this I shall refer presently. The accidents of childbirth are not above the average. In the mining valleys of this district the greater number of colliers' wives are attended by unskilled and ignorant midwives, none of whom are trained or registered. The sanitary condition of some localities is exceedingly unsatisfactory.

Neath Registration District (1.9 acres to a person) includes the old towns of Neath (12,000), Briton Ferry (6,000), Aberavon (6,000), Taibach (4,000), and Cwmavon (6,000), together with an extensive area studded with mining villages and farmhouses. In the mining villages many confinements are attended by midwives, but in the towns only a few comparatively. The sanitary condition is fair; but I should say that, if sewer-gas had any connection with puerperal fever, it would always be epidemic at Cwmavon, for "there is not a trap in Cwmavon." However, the reverse has been the case.

Pontardawe Registration District (2.1 acres to a person) is coterminous with the Pontardawe Rural District. It is only partly rural in character, and contains three mining and tinplate towns, together with a narrow valley with colliery population. There is a good water supply, but no system of sewers for any of its populous centres. All the

excrement is retained on the premises or deposited in the canal. Here the high death-rate from accidents of childbirth is difficult to explain, for there should be no difficulty to procure skilled medical assistance at a short notice.

Swansea Registration District (0.2 acres to a person) includes the town of Swansea (92,000), and the scattered mining districts of Llangyfelach (30,000). Sanitary condition far from being satisfactory. Midwives attend their share of confinements.

Gower Registration District (3.6 acres to a person) includes Gower (7,000), which is a purely agricultural area, and also the small seaside resort of Mumbles (4,000). Sanitary condition fair, and rate from puerperal fever somewhat high.

A consideration of the foregoing remarks leads me, as far as the county of Glamorgan is concerned, to the following conclusions:—

1. Puerperal fever often, though by no means as a general rule, selects for its ravages the most insanitary localities.

2. Our large and fair-sized towns show much the same mortality as similar towns in other parts of the kingdom.

3. In our densely populated mining valleys the mortality from puerperal fever is exceedingly high (Pontypridd, Merthyr, and Bridgend Registration Districts). This I unhesitatingly attribute, in a great measure, to unskilled and ignorant midwives.

4. The mortality from accidents of childbirth is only slightly higher than that for England and Wales, is unevenly distributed, and highest in a few of the mining valleys. In none of these places is there any difficulty of procuring skilled medical assistance at short notice.

What, then, are the circumstances and conditions of female life that determine these differences? In other words, what is the explanation that these mortality rates are higher in Wales than elsewhere?

Can a remark which the Registrar-General made twenty years ago in one of his Reports be true? "In North Wales, where the mothers are left to nature or to unskilful old women, the mortality is double that of London; and 9.4 mothers die to 1,000 children born." I must admit that there is a great deal of truth in this remark, but I will not have it that our old women are more ignorant or less skilful than any other old women. It is well within my knowledge that most of the confinements among the poorer women are attended by untrained women in the country districts of Merionethshire and Cardigan; in fact,

in all the country districts, villages, and small towns of Wales; and, from my experience in Glamorgan, which I shall shortly relate, I can prove, without a doubt, that they often spread puerperal fever broadcast, and are often not interfered with.

Can there be any other explanation of this high mortality in Wales? The conditions of life consequent upon the physical features of the country, especially in North Wales, often make it impossible to obtain skilled assistance in time; and if any is to be obtained it must be from untrained midwives, or friends or neighbours, who in such districts are often compelled to undertake this serious responsibility.

Is there anything in the natural temperaments of the women of Wales that renders them more susceptible to the infection of puerperal fever, or to succumb in childbed, than other women? This I am unable to answer, but I firmly believe that at least a partial explanation of this high mortality is to be found in the conditions of their life: for hard is the lot of women in the agricultural districts of Wales, and it is no wonder that they flock to our large towns. Farm servants, and even farmers' wives, work as hard, or even harder, than the men. In the summer months they are continually to be seen, even when pregnant, hard at work in the harvest field, and in winter attending to the cattle and sheep. Again, their food is of the poorest quality—in a word, they have to work too hard and do not get enough nourishment. This, I am convinced, has much to do with the prevalence of phthisis in these localities; and does it not also lessen their power of resistance to the inroads of any disease, and render them more likely to succumb to the accidents of childbirth? This is not the case in our mining districts, where wages are high and nourishing food plentiful. Many times has my heart bled when called upon to attend these poor women in the wretched hovels they often have to live and die in. What wonder is it that they succumb in their travail, especially when left to nature, to the ignorant midwife, or to friends or neighbours.

I will now relate some of my experiences in connection with an

Epidemic of Puerperal Fever,

which I am fortunate enough to have had. I say fortunate, because I believe that I was partly instrumental in putting an end to it. I was appointed Medical Officer of Health

for Glamorganshire in December, 1892, and arrived in time to investigate an epidemic of this malady which had been for some time raging in two adjoining valleys included in the Garw and Ogmore Urban District, and situated in the centre of our coalfields. The valleys in question run north and south, and are typical Glamorgan mining valleys—long, crooked, deep and narrow. Their higher parts are densely populated on both sides of the black and highly-polluted streams that run through each of them. Most of the houses are newly built, and sixteen or eighteen years ago there was only an occasional farm-house to be seen. The ridges of mountains on either side rise to a height of 800 to 1,200 feet above the sea level. The population of the two valleys numbers some 14,000, consisting for the most part of colliers and their families, with some tradesmen and artisans to minister to their wants. The houses are built of good quarried stone, and are dry and comfortable in the majority of cases. There are but a few privies, most of the houses having been in recent years supplied with pans and syphons, and connected with the public sewers. The water supply is good and plentiful. The incidents of the epidemic were briefly as follows:—

Puerperal fever had been prevalent in this district for many years; it is said to have been endemic in the Garw Valley. The number of cases that were reported, or came to the knowledge of the Medical Officer of Health for the four years 1889-1892, were, in

Year.	Number of Cases.	Recovered,	Died.
1889	9	4	5
1890	10	7	3
1891	14	12	2
1892	16	8	8
1893 (1st Jan. to 1st March)	18	10	8

so that, during January and February, 1893, eighteen cases occurred and eight proved fatal. In 1892 the number of cases was sixteen, with eight deaths; in 1891 fourteen cases with two deaths; in 1890, ten cases with three deaths; and in 1889, nine cases with five deaths; making, in four years and two months, sixty-seven cases with forty-one recoveries and twenty-six deaths. From the 1st January, 1892, to 1st March, 1893, thirty-four cases occurred: of the twenty-six in the Garw Valley, twelve were fatal; and of the eight in the Ogmore Valley, four were fatal. During this period (fourteen months) there were 793 births registered, showing a death-rate of 20.1

per 1,000 registered births, as compared with a mean rate of 2.5 for England and Wales. The following Table shows the number of other infectious diseases that occurred in the district in 1889 to 1st March, 1893:—

Infectious Sickness and Mortality (1889-92).

Year and Locality.	Population, Census 1881.	Population Estimated.	Registered Births.	Small-Pox.	Scarlet Fever.	Diphtheria.	Membranous Croup.	Typhus.	Enteric or Typhoid.	Relapsing.	Continued.	Puerperal.	Cholera.	Erysipelas	Measles.	Whooping-Cough.	Diarrhœa or Dysentery.
1889 Ogmore Ward	6893	—	—	0	80(19)	0	0	0	16(6)	0	0	4	0	0(1)	0(5)	30(5)	4(3)
1889 Garw Ward				0	180(28)	0	0	0	8	0	0	5(5)	0	0	84	20(3)	100
1890 Ogmore Ward	6893	12500	548	0	12(2)	0	0(1)	0	19(5)	0	0	8(3)	0	3	(8)	(8)	(4)
1890 Garw Ward				0	175(14)	0	0(1)	0	4	0	0	2	0	1(1)	(2)*	(3)*	(1)*
1891 Ogmore Ward	13080	13080	605	0	27(2)	0	0	0	6	0	0	8	0	2	(1)*	(2)*	
1891 Garw Ward				0	32(2)	0	0	0	5(1)	0	0	6(2)	0	0	(14)*	(10)*	(2)*
1892 Ogmore Ward	13080	15080	675	0	23(2)	0	0	0	36(8)	0	0	6(3)	0	2(1)	(1)*	(1)*	
1892 Garw Ward				0	41(5)	0	0	0	14(1)	0	0	10(5)	0	12(1)	—	—	(2)*
Jan. 1, 1892, to Mar. 1, 1893. Ogmore	—	—	—	—	—	—	—	—	—	—	—	8(4)					
Jan. 1, 1892, to Mar. 1, 1893. Garw	—	—	793	—	—	—	—	—	—	—	—	26(12)					

NOTE.—The number of deaths in each case is given in brackets.
* No returns of cases.

Particulars of Cases at Pontcymmer in the Garw Valley, from May 1892, *to March* 1*st*, 1893.

Name of Patient.	Date of Confinement.	Primipara or Multipara.	Midwife.	Duration of Illness.	Results.	REMARKS.
	1892.					
S....	May 14	M.	Mrs. P. ...	4 weeks	R.	Fatal scarlatina next door. House clean.
R....	,, 23	P.	,, ...	4 weeks	D.	
L....	June 13	P.	,, ...	7 days .	D.	
D....	,, 23	P.	,, ...	9 days .	D.	Scarlatina a few yards away.
R....	July 10	M.	,, ...	—	R.	
E....	Sept. 17	P.	,, ...	—	R.	
H. .	Oct. 31	M.	Mrs. T. ...	9 days .	D.	Drainage defective.
W. .	Nov. 7	?	Stranger...	4 weeks	D.	
D....	,, 29	?	Mrs. S. ...	—	R.	Drainage defective.
D....	Dec. 6	M.	Mrs. P. 2 ...	—	R.	Drainage defective.
J. ...	,, 7	M.	,, ...	—	R.	Drainage defective.
J. ...	,, 15	M.	Mrs. P. ...	—	R.	Scarlatina in house a short time previously.
R....	,, 23	M.	Mrs. T. ...	7 days .	D.	Disease developed the second day. Erysipelas upon baby and a man in same house.
	1893.					
E....	Jan. 1	P.	Mrs. P. ...	—	R.	Overflowing closet in basement.
Ll. .	,, 7	M.	Mrs. T. ...	—	R.	Insanitary surroundings.
D....	,, 20	M.	Mrs. P. ...	—	R.	
—...	Mar. 3	P.	Mrs. P. 2 ...	3 days .	D.	Drainage defective.
S. ...	,, 3	—	Mrs. R. ...	—	D.	Insanitary closet in basement.

Of the eighteen cases at Pontcymmer, seven were *primiparæ* and six of them fatal. Nine were attended by same midwife, and of these three were fatal. In six instances the drains were defective; in two the surroundings were insanitary.

Particulars of Cases at Blaengarw, in the Garw Valley, for a period of Two Years.

Name of Patient.	Date of Confinement.	Primipara or Multipara.	Midwife.	Duration of Illness.	Results.	REMARKS.
D....	1891. Mar. 3	M.	Mrs. Ll. ...	3 weeks	R.	Miner's wife. House clean. Natural labour. Second day rigor and temperature 102 deg. Third day temperature 104 deg. Severe abdominal pain and tenderness. Temperature normal on the 12th day. Mrs. Ll. also attended another case at the same place, which also made a good recovery. Doctor present at birth of child.
J....	Nov. 21	M.	Mrs. T. ...	2 weeks	D.	Wife of grocer. House clean. Natural labour. Rigor 7th day. Temperature varied from 102 deg. to 104 deg., but at last went up to 107 deg. a little before death. Cause of death, peritonitis.
M. .	1892. May 28	P.	Mrs. Ll. ...	4 weeks	R.	Instruments used. Severe post-partum hæmorrhage. Rigor 3rd day, temperature 105 deg. same evening. Slight abdominal pain and tenderness. Discharge foul.
D....	Dec. 31	P.	,, ...	14 days	D.	Miner's wife. Natural labour. Progressed favourably till Jan. 7th, when she sat up in bed to nurse the child. Rigor following morning, with a temperature of 102 deg. Great swelling and abdominal tenderness. Temperature 102 deg. Jan. 14th, temperature 107 deg. Death took place from peritonitis. House very clean. Slight post-partum hæmorrhage.
G....	1891. Mar. 8	M.	Mrs. T. ...	8 days	D.	Natural labour. Rigor third day. No abdominal tenderness. Lochia sweet. Death eighth day. Temperature 108 deg. No source of infection could be traced. House clean.
J. ...	1892. Nov. 16	P.	,, ...	7 days .	D.	Age 23 years. Easy labour. Rigor second night. Temperature 103 deg., with abdominal tenderness and sensation of lochia. None of the usual sources of infection could be traced.

Particulars of Cases at Blaengarw—continued.

Name of Patient.	Date of Confinement.	Primipara or Multipara.	Midwife.	Duration of Illness.	Results.	REMARKS.
B....	1892. Nov. 17	P.	Attended by a Doctor.	7 days .	D.	Age 21 years. Easy labour. Rigor second night, and temperature of 102.5; great tenderness over uterus, and foul lochia, although she had been washed with antiseptic lotions. This case was peculiar for its terrible and persistent vomiting. Her father, who lived in same house, was then suffering from a large wound of the leg. House clean.
M. .	Dec. 20	M.	Mrs. T. ...	—	R.	Forceps delivery. Rigor and high temperature on the fourth day which yielded to usual treatment.
M. .	,, 24	P.	Mrs. Ll. ...	7 days .	D.	Easy labour. Age 20. Fifth day rigor, high temperature 104 deg., tympanitis and abdominal tenderness. Lochia, although profuse, very foul; green vomiting. Died seventh day hyperpyrexia. The midwife in this case had attended a fatal case about a fortnight before this one, but in the interval had, so she said, thoroughly washed and boiled all her clothes at the wish of Dr. E.
H. .	,, 30	M.	Mrs. R. ...	14 days	R.	Forceps delivery. Rigor and high temperature on the third day. Temperature normal fifth day.
W. .	1893. Mar. 4	P.	Her Mother.	—	R.	Easy labour. Rigor and high temperature on the second day. History of erysipelas in the same house twelve months previously.

Of the eleven cases at Blaengarw, six were *primiparæ*, of whom four died. Four cases were attended by one midwife and four by another. Of the six that proved fatal, *all* were natural and easy labours, and three, at least, in young women.

The Nantymoel Cases.—About five months ago D. was confined in a house where the whole family, *six* in number, had suffered from scarlet fever. The last was convalescent at the time of her confinement. On the second day symptoms of puerperal septicæmia were developed, with a high temperature and foul discharges. The uterus was washed with a solution of perchloride of mercury, and in

a week the patient was convalescent and made a good recovery.

In about six weeks afterwards E. was delivered of twins. There was a severe rigor on the second day, accompanied by a high temperature. In a few days symptoms of *peritonitis* developed, and patient died on the eighth day. Was attended by H. L.

Particulars of Cases at Nantymoel and Tynewydd (almost adjoining), in the Ogmore Valley.

Name of Patient.	Date of Confinement.	Primipara or Multipara.	Midwife.	Duration of Illness.	Results.	REMARKS.
	1892.					
A. .	June	—	Mrs. A. W.	—	R.	
B....	,, 8	—	Mrs. H. L.	—	R.	
C....	Aug. 2	—	Mrs. Ll....	—	D.	The midwife in this instance was suspended for three months, but had since attended thirty cases without ill-effects.
D....	Oct. 10	—	Mrs. H. L.	—	R.	
E....	Nov. 10	—	,,	—	D.	
F....	,, 13	—	,,	—	D.	Mrs. H. L. was stopped attending for six weeks, but she afterwards attended three cases without ill-effects.
	1893.					
J....	Jan. 8	—	,,	—	D.	
H. .	,, 21	—	,,	—	D.	Mrs. H. L. was stopped attending for nine weeks, but has since attended six cases without ill-effects.
I....	,, 27	—	Mrs. A. W.	—	R.	
K. .	,, 27	—	,,	—	R.	

Two days after the death of E., F. was confined in same street, and attended by the same midwife (H. L.). Rigor on the *second* day, and signs of *peritonitis* on the third. She rapidly got worse, and died on the sixth day. During the interval between the first and second cases (above recorded), H. L. attended several cases without any signs of septicæmia. After the third case she was debarred from attending for *six weeks.*

At the end of six weeks she attended another case. This patient was very ill *three* days before her confinement, and *died three* days after delivery of violent peritonitis.

Four days afterwards, Mrs. H. L. attended another case, that made a good recovery in due time.

This same midwife went on attending confinements for *three* weeks without any ill effects until she attended H. This patient had a rigor on the second day, with a temperature of 101°. On the morning of the *third* day the temperature was 102°, and by four o'clock same day temperature was 107°. She became unconscious, and died at seven o'clock same evening.

After the above case the midwife was debarred attending up to the present date (March, 1893).

The above is a short account of the fatal cases at Nantymoel.

During the same period of about five months, A., I. and K. were attended by A. W., another local midwife. All these recovered.

This midwife has attended many cases since, and without any ill effects.

During the same period, and indeed during the year, several cases of confinement occurred, and were attended by *three* different midwives, where a slight rise of temperature was manifested, but they recovered. Influenza was prevalent at the time.

It was a very common occurrence in this practice to have slight cases of the so-called puerperal fever, but generally they were easily controlled by antipyretics and disinfecting injections, or, in fact, without any treatment whatever.

The notable features of the Ogmore cases were, that :—

(*a*) All the fatal cases (at Nantymoel) were attended by midwife H. L.

(*b*) All cases attended by midwife A. W. recovered.

(*c*) During the interval between the *first* and *second* fatal cases, H. L. attended several cases without the slightest ill effects.

The midwife A. W. did not cease attending cases for even a day, and, whilst H. L. was abstaining, A. W. probably attended a case daily on an average. *Two* of her cases were severe puerperal fever, and both recovered.

The above statements show that puerperal fever has prevailed to an abnormal extent in this district for the last *five* years—that it was *endemic*, and never entirely absent from the locality. I was informed by some of the oldest practitioners in the Garw Valley that cases of this disease have occurred there, at intervals, for *thirteen* years, and that it is, like typhoid fever, indigenous in some of the localities.

I have given an outline of the sanitary condition and

local peculiarities of the district, and I would only add that the two valleys are totally distinct, and separated by high hills of Penant sandstone, and that there is no intercourse between the midwives of the one and those of the other. Notwithstanding this fact, the disease has been prevalent in both valleys.

It is well known that defective sewerage and typhoid fever go hand-in-hand. This is clearly exemplified by the fact that Pontycymmer (in the Garw valley), and Tynewydd (in the Ogmore valley), the most insanitary spots throughout the district, suffer the most from typhoid fever. I should also mention that these localities are the most densely populated. It is possible, if not probable, that there might exist a close relationship between puerperal fever and bad sanitary atmosphere, containing sewer gases, arising from untrapped and badly ventilated drains or sewers, or from the soil, which is often damp and boggy, and impregnated with excrement and decomposing vegetable matter. Of this I cannot speak.

Again, scarlet fever is believed by some to have intimate relationship with outbreaks of puerperal fever.

Scarlet fever has been prevalent in these valleys for years, but the above Tables do not conclusively show the connection, if any, that exists between it and puerperal septicæmia. I have notes of several cases where confinements have happened in houses at the time infected with scarlet fever, and the experience of one of the medical practitioners (which coincides with my own) may be summarised thus :—

1. That the majority of cases confined in houses infected with scarlet fever, escape *entirely*.

2. That occasionally the mother takes scarlet fever, but does not develop any puerperal symptoms such as rigors, high temperature, abdominal tenderness, fœtid lochia, etc., and generally *recovers*.

The following are noticeable facts also.

1. That not a single case of diphtheria had been reported to the Medical Officer of Health during the last four years. Indeed, I am informed that the disease is not known in these valleys.

2. That *primiparæ* are more liable to be attacked than *multiparæ*. Out of twelve instances in which *primiparæ* suffered there were *eight* fatal cases, whilst out of *fourteen* where *multiparæ* suffered there were only *four* fatal cases.

3. That the fever more readily attacks, and is more fatal in, cases of *easy* and *natural* labours.

4. That the above statistics and history of cases do not afford conclusive evidence of the relationship, if any, between this disease and other zymotic diseases, such as *Erysipelas, Measles, Whooping-Cough* and *Diarrhœa.*

5. That a number of cases attended by *infected* midwives escaped entirely.

6. That the infection in this disease is most subtle, persistent, and portable, and more difficult to get rid of than in almost any other disease, or probably appears to be so, owing to the susceptibility of the puerperal woman to such an infection.

7. That all the *fatal* cases in one locality were attended by one and the same midwife.

8. That midwife P. attended *six* cases within a space of four months, and that *three* of these (primiparæ) terminated *fatally.*

I have already mentioned that nearly all the confinements in this and similar districts in the county are attended by midwives—professed midwives as they are called, and whose knowledge of sanitation, antiseptics, and infection is *nil.* I have interviewed a few of the above midwives, who frankly admitted that they were ignorant that they might have been the means whereby the disease was spread; and that up to a recent date, the necessary precautions against the spread of the disease were not observed, for the simple fact that they were ignorant of the danger connected therewith. Such a condition of affairs is not unique, viz., that midwives spread puerperal fever broadcast, and are not interfered with. Even local authorities, and I almost said Medical Officers of Health, require to be looked after.

Until recently neither the bedding, clothing, nor rooms of puerperal cases, whether fatal or otherwise, were in any way disinfected. Here again such a condition of affairs is not unique, and I can point to districts where no disinfection whatever is practised, or when attempted that it is a sham, and a very dangerous sham.

In connection with this epidemic, I made the following recommendations to the sanitary authority in whose district it occurred. They were carried out, with the result by now that scarcely ever does a case of puerperal fever occur.

*1. That each midwife, after attending a case of puer-

* You must not think that I am not a believer in antiseptics—far from it. I made the recommendation because I believed that no one would take the trouble to instruct these midwives how to disinfect themselves.

peral fever, be not allowed to attend another confinement for two months.

2. That the *bedding* and *clothing* of each puerperal patient be destroyed by burning, and that the bedrooms be properly disinfected by competent persons. The authority possessed no disinfecting apparatus.

3. That until the midwives are better instructed, trained and registered, the disease must go on in such a neighbourhood as this.

Do not these facts show that the fever, whatever its origin may have been, was spread by these midwives.

The fact that puerperal fever results from the attendance of females who have been engaged in laying-out and ornamenting the cadavera of persons who died of infectious maladies is well exemplified by the following cases which were reported to me, in 1893, by Dr. Dyke, Medical Officer of Health for Merthyr.

I. Cases attended by midwife *Alpha:*

(*a*) M. W., aged 40. Became ill from eating of decomposed tinned salmon. Died on 18th April; the cause of death certified as "peritonitis". Her body was laid out by above midwife.

(*b*) E. I., aged 38, was confined on the 19th April, attended by the same midwife. Notified as being ill of puerperal fever, and died on May 5th.

The residences of these two persons were in the same locality, in a healthy open street on the hill-side. Sanitary arrangement and water supply good.

II. Cases attended by midwife *Beta:*

(*a*) E. D., aged 38, confined on the 19th April, attended by this midwife. Notified as being ill of puerperal fever. On the 15th of April died, and on 18th body laid out by midwife Beta.

(*b*) E. L., aged 30. Confined on the 19th April, attended by midwife Beta. Notified as ill of puerperal fever, and died on 22nd April. Body laid out by midwife Beta.

(*c*) C. T., aged 23. Confined 28th April, attended by midwife Beta. Notified as ill of puerperal fever on the 30th April, died on 3rd May. Body laid out by midwife Beta.

The residences of the last three persons were a considerable distance from all those attended by Alpha. Sanitary

arrangements and water supply good. The midwives were warned not to attend cases until their clothing and persons had been disinfected. These warnings were disregarded, and I do not consider them sufficient.

It is recorded in *Public Health*, 1893, that one man lost three wives from puerperal fever, and when the case was investigated it was found that all three were confined in the same bed, which had not been disinfected.

I once traced a case to an infected bed where a child suffering from scarlet fever had died six months previously, and which had not been disinfected in the meantime. Neither the doctor nor midwife had been near a case of this, or any other fever, for months.

Once I came across a midwife with a sloughing ulcer on her leg, in attendance on a puerperal fever patient; and I should not be surprised, though I cannot prove it, that the disease had its origin in this ulcer.

I have seen women confined on several occasions in scarlet fever and diphtheria-stricken houses without any untoward symptoms whatever. In 1889 I contributed a short article to the *British Medical Journal*, in which I gave it as my opinion that this was the *rule*, and so far I have had no occasion to alter it.

I could adduce other similar instances in abundance, but it is unnecessary and tedious.

The Literature of Puerperal Fever.

Now let us glance very briefly at the literature of puerperal fever. This disease has been common to lying-in women in all ages and climates, and is described by Hippocrates, the first writer on the art of healing. Hippocrates, who contributed excellent clinical histories of the disease, did not only consider it as a dangerous disease but as a mortal one.

> "Morbus hic lethalis est, et faucæ effugere possunt
> Si mulieri pregnanti fiat in utero erysipelas, lethale est,"

and such were the views expressed by Celsus and Galen. Arabian physicians, such as Avicenna, as well as the physicians of the Middle Ages, have nothing more to say than that women in childbed sometimes took fever which led to their death. The medical writers of the sixteenth and seventeenth centuries go rather more into particulars. According to Hirsch, it was Willis who first looked upon it as a disease which was different to other febrile processes, and he gave it the name of "febris puerperarum"; and he

went so far as to connect its origin with laceration of uterus during labour, and refer it to a "miasma venenatum". By one writer, the obstetric art was described as "only fit for fools and old women"; and it was practised by them mostly until the establishment of a College of Physicians in London in 1518. In 1560 Thomas Raynold published his *Byrth of Mankinde.* From the time of Thomas Raynold to that of Ströther, who wrote in 1716, and first termed it puerperal fever, many eminent men have written about puerperal fever, but their views differed but little from those of former writers. Thomas Cooper (1766) looked upon the disease as a truly dangerous and perplexing malady, and that it proceeded generally from violent affections of the mind, such as grief, despondency, and the like.

Hulme (1772) declared the disease should be equally dreaded with the plague itself.

Denman (1788), according to Hirsch, was the first to allege that childbed fever was sometimes carried by doctors and midwives who had been in attendance on puerperal fever patients to other lying-in women.

With the exception of the statement that the disease was epidemic at Thasos in the time of Hippocrates, the earliest epidemiological notice is one relating to the Hôtel Dieu of Paris in 1746, when it is said that of twenty patients who were seized with the disease scarcely one escaped. It is also pointed out that the hospital was crowded with patients at the time, an unusually large number of them being cases of wounds, and the ventilation of the wards was extremely defective; and it is expressly stated that the lying-in department was directly over the wards occupied by the surgical cases. In 1830, Cruveilhier writes to the same effect on the epidemic of the Paris Maternité. Many similar accounts have been given afterwards with respect to our lying-in hospitals at home and abroad.

In 1779-1782, puerperal fever prevailed in an epidemic form at Aberdeen (Gordon's "Essay on Puerperal Fever at Aberdeen"). We are told, in connection with this epidemic, that it prevailed principally among the lower classes of women, but that women in the higher walks of life were not exempted; that it extended to the suburbs and contiguous country, where it proved as fatal as in the heart of the city. About eighty cases were attended by Gordon himself. To use his own words: "This disease seized such women only as were delivered or visited by a practitioner, or taken care of by a nurse, who had previously attended patients with the disease. In short, I had evident proof

of its infectious nature, and that the infection was as readily communicated as that of small-pox or measles, and operated more speedily than any other infection with which I am acquainted." The infection was carried by a midwife to the country parishes of Nigg and Fintray, and there also spread alarmingly.

The fever was epidemic in Leeds and its vicinity in 1809-12, and William Hey, jun., in his treatise on the epidemic, tells us that it prevailed principally among the poorer classes of women, but in the beginning it affected chiefly those in the higher stations of life, and in its progress they were equally liable to its attacks. Here it prevailed equally in both hot and cold weather. Dr. Hey writes: "It is somewhat remarkable that I have scarcely known an instance, in my own practice, of this disease coming on after præternatural delivery, or even a particularly hard labour. I do not mean to imply that such cases were more exempt from it than others, but so it has happened; and the fact shows that it was independent of anything untoward in the labour. It has, on the contrary, most frequently occurred, within the compass of my experience, after the most easy and most natural labour."

This is entirely in accord with my own observations already recorded.

I have known a medical man go straight from a puerperal fever case to a confinement where the operation of turning was necessary. He introduced his hand into the uterus, and the patient made a good recovery and was not infected with puerperal fever.

Armstrong (1813-14), in his description of the epidemic, in Northumberland, writes: "It is a singular fact that in whatever place the fever in question occurred, it was principally limited to the practice of one accoucheur in the place."

It would be interesting to give other instances, such as those recorded by Storrs (1842) in connection with the Doncaster epidemic; Blackmore (1831), epidemic of Plymouth; Simpson (1851), fatal cases at Edinburgh; Litzmann (1841-2) in connection with an epidemic at Halle; Martin (1856); Schulten (1859); Netten Radcliffe (1865), etc., etc. All these point in the same direction, and should serve to impress upon us that the question of *personal responsibility* cannot be too strongly urged upon *midwives* and *medical men.*

It was Semmelweiss (1846) that founded the doctrine of the septic nature of puerperal fever, by observing the

frequency with which it followed the exposure of puerperal women to cadaveric putrefaction. It was this observation of Semmelweiss, and the analogies of puerperal and surgical fevers first pointed out by Sir James Simpson, together with the investigations of Pasteur, Davaine, Rindfleisch, Koch, and others, on the part played by micro-organisms in disease, that led up to Sir Joseph Lister's system of antiseptic surgery.

According to Dr. Priestley (*Trans. Int. Congress of Hygiene and Demography*, 1891), it was Stadtfelt of Copenhagen (1865) who first applied antiseptic method to puerperal uses, in the maternity hospital of that town. He used carbolic acid; but later, M. Tarnier, in Paris, introduced corrosive sublimate as being a more efficacious germicide. Guided by the progress of antiseptic surgery a new departure was inaugurated in Germany, and then commenced the *aseptic*, as contradistinguished from *antiseptic*, midwifery.

The antistreptococcic serum when further elaborated may become an important factor in the prevention, as well as in the cure, of puerperal fever.

Its Prevention.

Notwithstanding the precautionary measures adopted in general midwifery practice, the alarming fact that 4,000 mothers are annually lost in England and Wales *still* stares us in the face.

What, then, is our duty in respect of this high puerperal mortality? Are we to trust to the repetition of *Abracadabra* as extolled by Sammonius; or are we to go to bed and dream about it as directed by Galen? This we have tried long enough!—and naturally without any beneficial result.

This same question was asked many years ago, and it occurred to some benevolent persons that the solution of the problem was in the establishment of lying-in hospitals, where women—poor, and destitute of comfort and means—as many are at their own homes, should be received and delivered. These institutions, after many years of anxious trial, have answered admirably; and it is to means similar to those which have been found efficacious in diminishing the mortality in them, that recourse must be had to procure a similar reduction in general practice.

The circumstances attending labour in the lying-in chamber are, however, vastly different to those in a lying-

in hospital, and the sources of danger more numerous; and, to use the significant and beautiful sentence penned by the late Mr. T. W. Thompson, of the Local Government Board, "Such improvement can only be brought about by a *full* appreciation of *all* that is known of the etiology of the disease, and an adequate sense of the responsibility on the part of *all those* brought into relation with the lying-in chamber."

Dr. Cullingworth (*Public Health*, Nov., 1888) has strongly advocated the more general use of antiseptics in private practice; and has particularly urged that every practitioner should recognise his individual responsibility in this matter.

To bring about this diminution of mortality is a work in which several sections of the community must take part, such as—

1. The parturient women themselves.
2. The midwife and medical attendant, *in particular*.
3. The Medical Officer of Health, Sanitary Inspector, and public bodies, such as Local Sanitary Authorities and County Councils, and
4. The Legislature.

Young women about to become mothers require instruction and special care, for by leading a natural life, in conformity with the laws of health, they often save both themselves and offspring; for few women in advanced pregnancy can stand the hard work to which, alas! they are too often exposed. Although childbirth is a physiological process, and under favourable circumstances (where the mother has been previously taken care of) is attended with little danger, yet every childbearing woman looks for some help in her travail; but many, even in these enlightened days, are left to Nature, or ignorant midwives.

Women in all ages and countries have done much noble work as midwives and nurses—the mother of Socrates was a midwife, "brave and burly."

A large proportion of mothers have been from time immemorial attended by midwives, and educated midwives as well as medical men are required to secure the best chance of life to the mother and child. This is a natural and excellent arrangement, as midwifery is a business for which intelligent women are admirably fitted. Until lately, and even now in some places, it was assumed that midwives were born and not made, and their training was entirely left to chance. At the present it rests on a very unsatisfactory foundation, although systematic instruction

has been imparted to them in some quarters. A very common cause of death in childbed is simply "the want of skilled assistance", and a mother's life often hangs on a simple act which can be easily performed by any intelligent woman who knows her work. In the absence of this the mother dies. There is scarcely a person whose life, or whose mother's life, might not at one time have depended upon the skill of a midwife. Newton had a narrow escape; and Goethe begins his autobiography by saying that, through the unskilfulness of a midwife he was born for dead, and, that only after manifold efforts on the part of those around him he saw the light of day.

It is true that a medical man can be called in, but he is not always at hand in the scattered and mountainous districts, when danger is imminent. To discover danger, a knowledge of its sources is required; and those of us who have come in contact with midwives of the Sairah Gamp's type are well aware that ignorance does not diminish their self-confidence.

No one who has reflected upon this subject, and certainly no one who has had practical acquaintance with it, will contend that the annual deaths in England and Wales of 4,000 mothers in childbed is not deplorable. Certainly, nothing should prevent those that have the public health at heart from giving this subject their most attentive consideration.

This matter has not received the attention it deserved, either at the hands of the legislature or public authorities. The provisions of the Midwives' Registration Bill now before Parliament would, in my opinion, meet the case to some great extent; but I would suggest that the training of midwives is a typical form of technical education, and is a work that ought to be undertaken by County Councils.* Certainly, in some way or another, assistance should be forthcoming to help intelligent women to fit them to render "first aids" to their sisters in travail. The utility of a recognised body of educated midwives, acquainted with the plain doctrines of health, and capable of rendering suitable assistance during labour, would be incalculable to the community at large. I do not mean that midwives should displace medical men in any way, where such can be obtained, but that they should be in a position to render valuable aid before his arrival, and to carry out his instructions faithfully as to the administration of

* This suggestion is by no means new: it was made several years ago by Dr. Thursfield, Medical Officer of Health for Shropshire.

remedies, the use of syringe and catheter, general cleanliness, the warming and ventilation of the room, the diet, and a thousand and one other acts on which the health and life of the mother and child depend.

The Medical Officer of Health and Sanitary Inspector can also render great help towards diminishing this mortality. The infected premises should be visited as soon as possible, and as soon as the case is over all sanitary defects should be remedied, and the house fumigated, the clothing of the midwife, soiled linen, etc., of the patient should be passed through a disinfector, or, failing this, destroyed; the midwife should undergo thorough antiseptic ablution, especially such parts as the finger nails, that are the most likely to retain infection. This is impossible in districts where disinfectors have not been provided, and they are many. It therefore becomes incumbent upon local authorities to procure such, and none should be considered fully equipped unless it has a bath-room and dressing-room in connection with it.

Before the Medical Officer of Health can be expected to accomplish these duties, the notification of infectious diseases must be compulsory, the tenure of his office secure, his salary must be adequate, and he must be debarred from private practice.

There are other avenues—now more or less shaded or obscured by the midwives' question—along which some of our efforts might well be directed.

Every wife and mother among the poor and artisan classes should be taught the elementary principles of nursing. There should be organised, in all our large towns and industrial centres, classes for the purpose of imparting instruction as to the care of the sick, the pregnant, and the parturient, and for diffusing knowledge of the primary laws of health. Again, the establishment of lying-in institutions should be encouraged in these localities, and the parturient poor induced to become patients over their confinements.

It is true that the Guardians of the Poor provide a lying-in ward in their workhouse-infirmaries; but there are scores of women in poor circumstances who would gladly enter a maternity, but refuse the lying-in ward of the workhouse because of the *stigma pauperis* connected with it, and accept the alternative of remaining at home, to be there—may-be, in the heart of unhealthy influences—attended by ignorant women, and often to face the risk of being fatally infected.

The dissemination of elementary knowledge of the nature indicated might well be encouraged by our County Councils and local authorities.

I have endeavoured to show that a very large number of poor women who are unable to obtain the services of medical men are attended in childbirth by midwives *alone;* how often it is that fatal results, and even epidemics, follow ignorance on their part of the means to prevent infection, and their inability to diagnose danger in time; and I feel convinced that this mortality in childbed among the poorer classes can be very materially diminished in the several ways I have indicated: especially if they are attended by sober and intelligent women, acquainted with the plain doctrines of health, and possessing an elementary knowledge of midwifery.

EDWARD JENNER.

(*Statement by the President*, 15*th May* 1896.)

BEFORE we begin the business which has brought us here to-night, it is right that we should recall to our minds that, one hundred years ago yesterday, Edward Jenner successfully inoculated the boy James Phipps from the hand of Sarah Nelmes, who had contracted cow-pox from her master's cows. This boy, Jenner tells us, "was on the 1st of July following inoculated with variolous matter immediately taken from a pustule. Punctures and incisions were made on both his arms, and the matter was carefully inserted, but no disease followed. Several months afterwards he was again inoculated with variolous matter, but no sensible effect was produced on the constitution."

This was the first case of intentional inoculation with cow-pox of one human being from another: the first of a long series of protective inoculations upon which, for a hundred years, man has been dependent for his protection against one of the most terrible diseases to which he is exposed.

From this inoculation has grown our national system of vaccination, in the creation of which the name of this Society and its former president, Edward Seaton, will be everlastingly associated. Recognition of our Society in connection with vaccination comes to us to-night from Bohemia.

That a Royal Commission should now exist in the land of Jenner as a result of outcry against vaccination, is a striking illustration of the unwillingness of one generation to profit from the experience of its predecessors. Small-pox has, indeed, owing to Jenner's work, lost so many of its terrors, that its risks are often forgotten, and the necessity of vaccination often fails to be recognised.

With the student of epidemiology, however, vaccination now stands on a firmer base than before, for a century's experience has made us understand the extent of its value, the manner in which it can best be utilised and the results attendant upon its neglect.

But Jenner's work does not stand related to the prevention of small-pox alone; it was the beginning of a branch of knowledge increasingly applied in our time to the saving of human life from destruction by other communicable diseases.

Our Society, in its desire to honour Jenner, to recognise the greatest medical service ever done to man, has decided to found a Jenner Memorial Medal, which will from time to time be conferred upon those who may by their own work contribute to the knowledge which tends to the prevention and control of epidemic disease.

PRAGUE, *the* 13*th May* 1896.

SIR,—I have the honour to beg you to accept the best congratulations of this Society on the hundredth anniversary of the first public demonstration of arm-to-arm vaccination made by Mr. Jenner on the 14th of May, 1796, and I congratulate you on the successful effect of the wonderful discovery throughout the whole civilized world.

I am persuaded you will be so kind as to communicate the contents of this letter to your Society.

I finish the letter with the expression of sincere thankfulness in the memory of the great Briton, and remain with best respects,

DR. HENRY ZÁHOŘ,
President of the Bohemian Society for the Advancement of the Care of Public Health at Prague in Bohemia.
DR. VLADIMER PREININGER, Secretary.

Mr. SHIRLEY F. MURPHY, President of the Epidemiological Society of London, London.

INFECTIOUS SORE-THROAT AND DIPHTHERIA.

By GEO. REID, M.D., D.P.H.

(*Read: 15th May* 1896.)

It is with considerable diffidence I venture to direct your attention to a subject of so debatable a character as infectious throat ailments, and I wish to emphasise the fact that my only object is to present for discussion certain impressions I have formed as to the nomenclature of such ailments—impressions which in the first instance were the outcome of personal observation, but which have since been strengthened by the experience of others. I cannot say I have any definite theory to advance, as my impressions are too visionary to admit of being formulated; but, such as they are, they may serve as an introduction to what may prove to be a useful debate upon a subject in which we are all keenly interested, and concerning which there is by no means unanimity of opinion, namely—the relationship between diphtheria and allied infectious throat ailments.

It is a generally recognised fact that diphtheria outbreaks are frequently preceded by, and associated with, throat affections of a comparatively trivial character, which, however, do not present the typical features of diphtheria proper. Also, in recent years, bacteriology has introduced a considerable element of doubt as to the true nature of certain throat ailments which previously would have been pronounced to be diphtheria, and the term pseudo-diphtheria has been coined in consequence.

Under the circumstances, and until our knowledge of such ailments becomes more exact, this term will serve a useful purpose in limiting the risk of minimising the danger of outbreaks in which bacteriological proof is wanting, and in stimulating inquiry into the true nature of these so-called spurious ailments.

Dr. Thorne Thorne, who in his well-known "Milroy Lectures" has so ably presented the evidence on this question—to which, indeed, he himself has so largely contributed—propounds the theory "that attacks of so-called

sore-throat exhibit under favouring conditions a progressive development of the property of infectiveness, culminating in a definite specific type which is indistinguishable from true diphtheria." This theory, I think, has been pretty generally accepted, although its accuracy has been doubted by more than one observer. It is in some measure in support of these doubts that this paper has been written, although I fear, as I have said, it may be thought I have nothing more substantial in the shape of a theory to offer in its place.

In these days of germ diseases one can well understand why the throat should be a favourite site for septic ailments conveyed by the air and by food, but, according to our present nomenclature, the number of such ailments is very limited. Excluding scarlatinal sore throat, which is fairly distinctive, and although frequently associated with other nondescript throat ailments, may usually be differentiated from them by accompanying symptoms which are characteristic of the disease, the list of septic throat ailments is narrowed down to diphtheria, pseudo-diphtheria, and an ill-defined affection called lacunar or follicular tonsillitis, membranous croup being now usually regarded as laryngeal diphtheria. Quinsy, it would seem, must be classed with other simple catarrhal inflammations, which are neither infectious nor septic; and, strictly speaking, mumps can hardly be looked upon as a throat disease.

The symptoms of all inflammatory throat ailments are, naturally, owing to physical causes, more or less identical. When we consider that the physical effects which result from scalding the throat with hot water may give rise to symptoms which are hardly distinguishable from so-called membranous croup, it is not surprising that idiopathic inflammatory throat affections should occasionally be mistaken one for another, and it is but reasonable to ask, whether under the term lacunar or follicular throat, several distinct though symptomatically allied diseases may not be included.

This idea, which for some time I had entertained, was very forcibly impressed upon me three years ago by the occurrence of a nondescript throat outbreak, apparently of an infectious nature, in which I was consulted. This outbreak formed the subject of a paper I read, soon after its occurrence, at a meeting of the Birmingham and Midland Counties Branch of the Society of Medical Officers of Health, and the conclusions I arrived at were warmly discussed and by no means generally accepted, although

several observers have since then recorded outbreaks which bear out my contention.

In support of the theory which I will afterwards attempt to explain I will trouble you with a short account of these outbreaks.

The one in which I was interested occurred in a village school in a scattered rural district of Staffordshire. It was not until about a fortnight after the first cases occurred that the Medical Officer of Health of the district became aware of their existence, and he consulted me regarding them the following day. On inquiry, I found that the disease started in the infants' department of the school, beginning with twelve cases, and increasing daily up to that time. Ten days after its first appearance the numbers attacked greatly increased, and then the older children, whose class-rooms it is important to note were situated some distance from the infants' department, for the first time showed any symptoms of attack. By the date of my visit, at least one-third of the three hundred children attending the school either had suffered, or were suffering, from the ailment; and at that time the whole staff of teachers, including the schoolmaster and his wife, the assistant-mistress, and the pupil-teacher, were actually ill, some of them seriously so.

The first symptoms complained of were headache, feverishness, and pain on swallowing; on the second day the throat began to swell and become painful, and the patients, as a rule, felt too ill to get about. In addition to the throat symptoms, the lymphatics of the neck became swollen and tender, in some cases very much so, in others less, but in all to some extent; in fact, the swelling and tenderness in many of the cases was so great that the master of the school thought the patients were suffering from mumps, until he was disabused of this idea by the Medical Officer of Health, who was consulted only when the master's own children were attacked. The throat appearances resembled those of follicular tonsillitis, and in none of those examined, either by the Medical Officer of Health or by myself, was there any trace of diphtheritic membrane to be found; neither was any skin rash apparent. About the fourth day the acute symptoms began to subside, but the tonsillar swelling and the enlargement of the lymphatics remained for some days after the patients were able to swallow ordinary food. There were no fatal cases, and although careful inquiry was made concerning upwards of a hundred children who had suffered, no sign of any

paralytic trouble, however slight, was met with. As regards the numbers attacked among the three hundred children attending the school, during a period of about fourteen days previous to its closure, when the disease appeared to die out, it is probable that the hundred known cases did not represent the total, for on examining some of the throats of the children who had not complained, I discovered that some showed symptoms of the affection in a mild degree, accompanied in some instances by slight glandular swelling—the most striking symptom in the more pronounced cases.

As regards the possible origin of the outbreak, two or three days previous to the occurrence of the first cases an old drain had to be opened at a point immediately under the windows of the infant class-room, in connection with certain structural alterations which were being carried out. This drain—which was allowed to remain open for a fortnight, although it had been covered in previous to my visit—was found to be almost completely obstructed with foul deposit, the smell from which was said to be most offensive. Besides the sink waste from the schoolmaster's house, the school privies and urinals were all connected with the drain, so it is not surprising that a most offensive nuisance was experienced when it was opened.

In view of the possible connection between this nuisance and the sudden outbreak, the order of attack is of interest. As I have stated, it was in the infants' department that the first cases occurred, and these happened almost simultaneously, a few days after the opening of the drain. After this, for some days, there was a lull, followed by a sudden increase of attacks—also in the infants' department—which was maintained for a week before the affection broke out among the elder children in another part of the school. A Table which I prepared at the time, showing the daily percentage of absentees in the respective departments for some weeks previous to the outbreak, and up to the day of the closure of the school in consequence of it, indicated this very plainly, but the fact in itself was so apparent that the schoolmaster had observed it, and called our attention to it.

If, then, one is right in attributing the outbreak to the drain nuisance, it would seem that a certain number of children—the more susceptible possibly—contracted the ailment from the original source of contagion, and that the others were subsequently infected from them direct. This theory is also borne out by the fact that the infants, whose

class-room was in close proximity to the open drain, were attacked in the first instance, while the elder children in the more distant class-rooms—the windows of which, I should mention, were all on the other side of the building from the open drain—were not attacked for some eight or ten days.

As against this theory of infection, however, it is but fair to state that a house-to-house inspection of the village failed to afford any very positive evidence that the school children who had suffered had conveyed the disease to others not attending the school. It is true that here and there an inflammatory throat was met with, but the symptoms were of the mildest description and unattended by glandular swellings.

As to the nature of this outbreak, I unfortunately have no bacteriological evidence, either of a positive or negative character, to offer, as the facilities which now exist for conducting such investigations were not then conveniently available. I have no hesitation in saying, however, that, apart from the fact that the ailment was located in the throat, and was attended with glandular enlargement, there were absolutely no diphtheritic symptoms. The fact also, that among upwards of 100 persons who suffered no fatal cases occurred, although the illness in many instances was by no means trivial, together with the entire absence of subsequent paralytic symptoms, points to the non-diphtheritic nature of the ailment. The impression I formed at the time was that everything pointed to this being a specific infectious throat affection, with characteristic symptoms which, viewed collectively, did not fit in with any named disease; and this impression has since been strengthened by other recorded examples of outbreaks, the symptoms of which resemble in a marked degree those of the school outbreak I have described.

Two years ago Dr. Wheaton read a paper before this Society entitled, "Certain Affections of the Mucous Surfaces and their Relation to Diphtheria," and from his description of the symptoms in outbreaks he had met with, it would appear that the cases resembled very closely those I have just referred to. His attention was first directed to these ailments in 1890, when they were very prevalent in a district in South London. Up to the date of the reading of his paper he had seen about 150 cases, and had exceptional opportunities of watching the course of the disease, as several of the cases were under his care in hospital. From notes which he preserved of over thirty cases, he

describes the symptoms very fully, and his description may be summarised as follows:—The face of the patient is at first flushed, swollen, and puffy, and in all cases there is marked enlargement of the glands on both sides of the neck, together with tenderness on pressure. Indeed, it was pointed out, as in my cases, that the swelling of the glands of the neck, which persisted for a considerable time after all other symptoms had disappeared, was one of the most marked features of the affection. At the commencement of the disease there is more or less swelling of the palate and fauces, and also, in some cases, but not invariably, of the tonsils. The throat presents red, injected patches, with a central white film, which soon, however, disappears, and is rarely to be seen from twenty-four to forty-eight hours after the first appearance of the symptoms. After the disappearance of this film, which has none of the microscopic appearances of diphtheritic membrane, a red, raw surface is exposed, very much resembling the exposed surface after the separation of the membrane in cases of undoubted diphtheria. The temperature at first rises to 102 deg. to 103 deg., but in the course of two or three days, it subsides to normal. The illness is followed by prolonged debility, but, although the patients were under observation for from four to six weeks, no paralytic sequelæ were observed in any instance. There were no fatal cases.

Dr. Wheaton then referred to certain affections of the mouth, nostrils, and vulva, presenting identical appearances to those described, which had also come under his observation, sometimes associated with the throat affection, and at other times not, and which bacteriologically proved to be identical. Subsequently, in 1893, Dr. Wheaton met with a similar outbreak, associated with an epidemic of diphtheria, in a town of about 10,000 inhabitants, where the evidence pointed to the public elementary schools as being the chief means of spread. It is interesting to note that, besides the cases of this throat affection associated with diphtheria, it was found, on inquiry at the houses of the town, that similar cases occurred unassociated with diphtheria, in families in which no children attended school. Also, the infection was found to exist in an institution in which none of the children had been attacked with diphtheria.

The bacteriological evidence in Dr. Wheaton's cases was entirely negative; no organisms resembling the bacillus diphtheriæ were ever found, neither was the "thrush" fungus nor any other fungus met with; but a micrococcus

growing in orange-yellow colonies was always obtained by cultivation tests with the throat pellicles and secretions.

Dr. Thresh has paid considerable attention to this subject, and for some years past has carefully inquired into all throat outbreaks in schools, special notice of which had been sent to him, at his request, by various schoolmasters. By this means his attention was directed to many such outbreaks, and the information he thus acquired, in addition to facts ascertained in consultation with local medical officers of health, formed the subject of a paper which was read at the Home Counties Branch of the Society of Medical Officers of Health a year ago.

In this paper Dr. Thresh detailed the facts of nine or ten outbreaks to which his attention had been directed. In some instances true diphtheria cases were met with, associated with cases supposed to be diphtheritic but which proved not to be so; and in other cases Dr. Thresh came to the conclusion that the throat symptoms were symptomatic of influenza. On more than one occasion, however, somewhat extensive outbreaks occurred, which, although infectious, did not present the symptoms of diphtheria, and in which bacteriological examination failed to detect the presence of the bacillus. Dr. Thresh thus describes the typical symptoms of such cases:—"One or more points in the mucous membrane of the tonsils, soft palate, or uvula become infiltrated, appearing paler than the surrounding membrane. The patch becomes paler and paler until nearly white. It is but slightly, if at all, raised, and has no sharply-defined margin. Before becoming white the infiltrating material may be absorbed, and the part resume its normal appearance, but when it has assumed the milky white colour, it finally peels off, leaving a shallow ulcer which speedily heals. It may or may not be associated with a mild form of tonsillitis. The constitutional disturbance as a rule is very slight, but occasionally there are marked premonitory symptoms—headache, nausea, languor, and feverishness—but these speedily pass away and the patient feels fairly well." Dr. Thresh also refers to an accompanying glandular enlargement, so marked in many of the cases that they were regarded as mumps, although the patients had no affection of the parotid gland.

As regards the bacteriology of these cases, Dr. Thresh found various organisms associated with them, but came to no definite conclusion as to whether they had any direct causal relationship to the disease. In concluding his paper, he said :—"One thing is becoming clear: that under

the name 'diphtheria' we are including two, if not several, distinct diseases, due to the development of different organisms on or in the mucous membrane of the throat. Amongst the countless multitude of micro-organisms which occur in nature, it would indeed be wonderful if one only were capable of developing upon nature's medium, and in nature's incubator, and of injuriously affecting its host. During sleep, the back of the mouth forms the incubator *par excellence.* Many different organisms flourish there, more than one of which are probably capable of penetrating the mucous membrane, and causing its infiltration and exfoliation; and the products of its metabolism, toxins, etc., becoming absorbed, may be the cause of constitutional disturbances, such as those described in connection with the epidemics of 'sore throat'."

An interesting discussion followed the reading of the paper, and Dr. Turner, the President on the occasion, referred to a small epidemic which occurred in a village in his district, in which the symptoms were very similar. "The patients," he said, "suffered from sickness, headache, rigor; they recovered rapidly from the acute symptoms, but were much pulled down by the disease, and only regained their full strength and health slowly. In many, the submaxillary glands were much enlarged, leading to a diagnosis of mumps. No adults were attacked, there was no clear history of any rash, no desquamation, and no loss of accommodation or other paralysis."

Among other nondescript infectious throat outbreaks which have recently been recorded, may be mentioned one which occurred in the Finchley district, and was investigated by Dr. Kenwood. This outbreak presented several interesting features. The disease attacked adults in preference to children, in the proportion of two to one, and the origin was traced to a certain milk-supply from a dairy farm where three of the cows were found to be suffering from a febrile ailment accompanied by ulcerated teats. Milk from this dairy was supplied to seventeen per cent. of the houses, and ninety-four per cent. of the families attacked obtained their supply from this source.

Gentlemen, I think it will be admitted that the occurrence of the outbreaks which I have shortly summarised points to the existence of other throat ailments of an infectious nature besides scarlet fever and diphtheria. It is true these ailments are often associated with diphtheria and scarlet fever, but sometimes they are met with alone. Also, although one outbreak may differ from another in

some respects, they have many features in common, and, apart from differences in degree, the cases in each outbreak strikingly resemble each other; and one cannot but look upon them as specific although unnamed ailments, which are entitled to a special place in the zymotic group, even if, for the present, no more distinctive name than "pseudo-diphtheria" can be found for them.

I would now refer, very shortly, to the possible light which such outbreaks throw on the "progressive development" theory. First, however, as a basis of argument, I must attempt to define what, as I understand, is meant by that theory. It would seem to imply that under certain conditions throat ailments, which present no characteristics of diphtheria, and are not even infectious, may in the course of an outbreak assume infective properties, and ultimately become truly diphtheritic, as proved by the presence of the characteristic bacillus: the development process being a gradual one, brought about by conditions intimately associated with the patients themselves or their surroundings.

Now I may say at once that I am willing to accept this theory, provided it can be shown to be the only reasonable explanation of events. In fact, I am prepared to go almost any length in upholding evolution as a factor in the production of zymotic disease, but I am inclined to think that it operates in a less radical fashion. For example, it is not unlikely that a mild ailment of a specific type may, by progressive development during the same outbreak, assume a more malignant form, but this is very different to the transformation of one affection of a specific type into another of a different type. To my mind, if this were possible, one might with as much reason conclude that measles may develop into whooping-cough, or small-pox into scarlet fever.

Evolution, in my opinion, exercises a most potent influence in the production of disease, but there are limits to its operation. It is likely that to it is to be attributed the apparent *de novo* production of disease—an occurrence, indeed, which is sometimes used as an argument against its bacterial origin, because it is supposed that it occasionally implies a belief in the re-creation of life. This argument was recently made use of by Dr. Harrison, who hesitated to accept as proven the bacterial origin of diphtheria, because of his experience fifty years ago in Ontario. He writes:—"Diphtheria reached us before railways had opened up the country, and I repeatedly saw it on isolated

farms surrounded by woods, and where it could not possibly have been carried from without, and where the land had been so recently redeemed from the forest that it could not have been derived from some previous but forgotten case."

In reply to Dr. Harrison, I would ask why should we be at a loss for an explanation of such an occurrence, when we know that under our very eyes organisms assume different forms and shapes, through infinitesimal changes in their environment brought about by artificial means, and that the chemical products of their existence—which, in all probability, are in most cases the active disease-poisons—are entirely altered by the process? May not similar changes be constantly brought about by natural processes, and, if so, does not this explain the apparent mystery? If, owing to the extreme morphological variability of micro-organisms their character and habits can be altered by artificial means, such as a change of pabulum, a lowering or raising of temperature, a moistening or drying of their surroundings, may not similar changes, acting in nature, be instrumental in transforming, not one type of organism into another type, but one in a non-pathogenic phase of its existence into a pathogenic phase, and thus give rise to disease. A great deal more than this must take place, however, if the progressive development theory implies all that it would seem to imply, when viewed in the light of the outbreaks to which I have called attention.

In all probability, in the case of my school outbreak, had a case of diphtheria been introduced into the school many children would have been attacked, in consequence of the favourable field which the already impaired throats presented for the reception and growth of the bacillus; and in that case it is highly probable that the outbreak would have been cited as an example of the progressive development theory. In the case of similar outbreaks to which I have referred, diphtheria did break out and run concurrently with the other cases; and Dr. Kenwood mentions a case in which thirty persons suffered from true diphtheria during an outbreak of so-called acute follicular tonsillitis, ten of whom showed the first symptoms of the disease after convalescence from the original ailment had been well established, and the throats had resumed almost their normal appearance.

It is now known that the bacillus diphtheriæ is frequently found in perfectly healthy throats; it may be, therefore, that an impaired surface is essential to its development, and that this is the sole explanation of the fact that diphtheria

outbreaks are so frequently associated with milder throat ailments.

This is the conclusion that Dr. Wheaton arrived at, and so well expressed in summing-up his paper on the subject from which I have quoted.

He said:—"To summarise these foregoing observations, it would appear that the clinical, pathological, and bacteriological evidence which I have been able to bring forward tends to show that these affections are not diphtheria, nor a mild or modified form of diphtheria. The evidence derived from their study from an epidemiological point of view indicates that these affections may prevail apart from diphtheria, and under circumstances in which their origin by infection from diphtheria is negatived. On the other hand, it appears that in outbreaks of epidemic diphtheria these affections may, and do, sometimes accompany and precede the epidemic, and it appears probable that the prevalence of these affections has a large share in determining the outbreak of diphtheria in an epidemic form in some instances. The way in which these affections act is probably by creating a lesion of the mucous surfaces by which the virus of diphtheria obtains entry; or, on the other hand, it is probable that there may be a condition of commensalism in these two affections, and that epidemic diphtheria may be likened to a lichen in the vegetable kingdom, which consists of a fungus parasitic upon an alga; the alga being represented by the thin film or pellicle existing in these affections, and upon which the more powerful and predominating virus of diphtheria becomes—like the fungus—grafted, and flourishes. If this is the case, the contradictory conclusions of bacteriologists who have investigated diphtheria may be perhaps explained."

Gentlemen, this question is not merely one of scientific interest. If the contagia are often the outcome of a process of evolution dependent upon agencies which are within our control, may we not, by exercising that control, be able to stamp out such diseases before they can get hold of our bodies, and so propagate themselves direct from person to person. So far, our efforts in the case of those affections we are considering this evening have not been successful, but with improved knowledge of the life-history of the responsible bacteria, I believe that such diseases will no longer remain the only ones in the zymotic class which have not yielded to the advance of sanitation.

AN OUTBREAK OF TYPHOID FEVER IN BEYROUT, SYRIA.

By JOHN WORTABET, M.D.

(*Read: 15th May* 1896.)

On the 14th of October 1895, there was a heavy fall of rain, which in a couple of hours measured more than four inches, and produced a considerable inundation. About a fortnight later a large number of people fell ill with fever, and it soon became clear that we had to deal with a widespread epidemic of typhoid. The attacks were, approximately speaking, simultaneous, and, if allowance be made for a short difference in the stage of incubation, the vast majority of the cases were probably infected on the same day. Not less, perhaps, than 2,000 cases, which is about two per cent. of the population, were the result of that general infection. The subsequent history showed that the infective matter must have been highly concentrated or virulent, for the characteristic symptoms were all very severe, the duration of the disease unusually long, and the rate of mortality high. It showed also that the medium of infection must have been widely diffused over an area of some miles. For extent and severity of the epidemic, nothing like it in the memory of the physicians and oldest inhabitants had ever been seen.

With very rare exceptions, the age of the patients was between five and twenty-five years. A few of the cases were mild, and recovered about the twenty-second day, but the most were protracted to the fifth and sixth week. These last were generally very severe, and the temperature, rash, diarrhœa, delirium, and prostration very marked. The intestinal lesion was unusually severe, many had excessive hæmorrhage, and some died of perforation. In one case of autopsy, ulceration of Peyer's patches and of the solitary glands was very extensive, and involved not only a large part of the small intestine, but extended as low down as the sigmoid flexure; and it was probably on account

of this lesion that the course of the disease was so protracted, convalescence so slow and tedious, and relapses so frequent. In fatal cases, death took place most generally between the third and fifth weeks, either from the toxic effects of the disease, from exhaustion induced by hæmorrhage, or from intestinal perforation and consequent peritonitis. It is difficult to assign the fatality-rate, but it could not have been less than 15 per cent., and probably it was higher. Of the fifty-four cases which I saw in consultation with the medical men who were attending them, twenty-four were unusually severe, and of all those which I could follow up fourteen died, fourteen had intestinal hæmorrhage, and at least five died from perforation. A medical friend of mine saw forty patients, of whom ten were in consultation, and of all this number fourteen died. After the actual invasion of the epidemic, which can be assigned with a considerable degree of certainty to about the 29th of October, there were very few fresh cases which, most probably, were infected more or less directly from the first crop of patients. I believe these were all comparatively mild, and, so far as I know, they all recovered. But new cases are, at the time of writing this report, still appearing, and will continue to appear, until they cease ultimately to propagate themselves.

The main point of interest in this epidemic is undoubtedly the cause which produced such a widespread and synchronous disaster. Before proceeding, however, to any consideration of this important subject, it will be necessary to say a few words on the water-supply of Beyrout and its sanitary condition. For the last twenty years this town, whose population probably *exceeds* 100,000, has been supplied with its water by an English Company from the Dog River (the ancient Lycus), which runs into the sea about five miles to the north. The sources of this river are two springs—one issuing from a series of deep caverns about six miles from the estuary, the other is an open fountain, about a hundred yards lower down; the water from both sources is exceptionally good. A part of this water is taken by the Company and turned into an open canal, which runs by the side of the valley to the distance of about two miles. It then flows through a tunnel three-quarters of a mile long, and emerges on the southern side of the hill, where it runs again for a short distance in an uncovered canal, and is passed through a filter-bed made of a number of layers of fine sand, coarse sand, and pebbles.

The filtered water is pumped by steam-machinery into iron pipes, which carry it to two reservoirs on the eastern side of the town, and which are situated on a height above the level of the ridge and slopes of the low hill on which the town is built. The pipes are perfectly fitted, and the water thus supplied has been repeatedly analysed and found to be unusually good. To this pure water and its mode of conveyance and conservation there is every reason to believe that Beyrout owes its immunity from cholera since 1875—the year of its last visitation. Typhoid fever has also decreased very considerably, but is not wholly extinct —sporadic cases, or a very mild epidemic, appearing occasionally.

The sanitary condition of the town is supposed to be managed by the Municipal Corporation, but in the East the value of the public laws of health is unknown or wilfully neglected. The old town—a remnant of ancient times—has a few very imperfect drains into which some of the sewers find their way, and whose ultimate destination is the sea. The streets are narrow and dark, badly paved, and their air is heavily laden with the gases from broken drains and accumulated filth. The houses are high, and overcrowded with the poorer classes. The new part of the town, which is several times as large as the old, receives the excreta into cesspools or covered pits which are cleaned out from time to time, while the house-slops are conveyed to an open ditch by the side of one of the walls. The better class of houses, which stand on their own grounds, or on some of the heights of the town, are now often provided with syphon-traps, and are comparatively free from immediate noxiousness. The streets have no side-walks, are very dusty in summer, and full of mud in wet weather. The side-gutters which receive the slops of houses and the dirt of the streets are open, imperfectly made, and are generally the receptacles of offal and filth, and the source of noxious emanations. A worse condition of things, for a well-to-do place with more than 100,000 inhabitants, can hardly be conceived. Sporadic cases of typhoid fever and of diphtheria, and occasionally a mild epidemic of either, are not uncommon.

But there was nothing new or special, so far as we know, in the usual insanitary condition of the town which could account for such an extraordinary outbreak, evidently the work of a single day; nor was there in the excessive fall of rain on the 14th of October anything which in itself,

and apart from the possibility of its washing down from some infected spot the specific germs of typhoid fever, might explain it. The ordinary modes of communicating this disease, such as the soiled hands of nurses, contaminated vegetables and fruits, milk mixed with infected water, sewage air carrying typhoid bacilli inhaled and swallowed with the saliva, might well account for sporadic cases, or a number of them in a limited locality; and indeed it is certain that there were such cases in the town before the present outbreak. But in an epidemic, when so many people living at distances so far apart were attacked simultaneously, the cause must be sought in some widely diffused medium which can only be air or water generally contaminated. In either case the infection must have been carried, apparently in one day, throughout a large town covering a good number of square miles. If it were in the air we have to suppose nothing less than such conditions as these—a fæcal mass heavily charged with typhoid matter is laid on the surface of the soil, dries up, crumbles into dust, and its atoms carried by the wind through a large area of space. On the other hand, if water was the medium of infection, we must suppose that fæcal matter containing the germs of the disease found its way into the uncovered canals of the water supply of the town and contaminated it before reaching the iron pipes; or the reservoirs may have received the infective matter through the subsoil from some of the neighbouring houses whose site is a little higher; and finally the iron pipes may not be impervious to such minute objects as typhoid bacilli. The two latter suppositions seem to be inadmissible on the evidence of the highly competent engineer at the waterworks, who says that the reservoirs are so well constructed and cemented that no infective agent can penetrate their walls, and that the water-pressure within the pipes would equally prevent any such ingress. This makes the first presumption to be the most likely explanation of the water agency; and, in any case, once in this medium, the infection of so many people, living at so many different and separate points, but supplied by the same water, may be readily imagined. The probability that this was the source of the mischief is very much confirmed by the fact so often observed by careful medical men, and so generally admitted now by the profession, that the great factor in causing both typhoid fever and cholera is contaminated water. In no other way can we reasonably account for such an epidemic

as that through which we have just passed. If some of the localities—such as the barracks and a few schools—escaped, either wholly or comparatively, while others suffered severely, any objection raised on this ground would apply with equal force to the dissemination of the disease through the agency of air as of water.

IN MEMORIAM.

THOMAS WILLIAM THOMPSON.

THE earlier pages of this volume contain a paper from the pen of Thomas William Thompson, the later pages must contain the record of his death. To his friends his loss is irreparable; he can never be forgotten by those who knew and loved his manly qualities, his generous sympathies, and his splendid abilities. To the Society his death is a calamity, for few are endowed with the power to read nature which gave to Thompson's work a value of its own.

But not less necessary for this work, upon which Thompson and the Society were alike engaged, was his ability to consider his subject from every view-point; to state in exact proportion the evidence which told in favour of, or against, a hypothesis that had to be examined. There has passed into the hands of the Society an unfinished piece of his work, a mere fragment, probably never intended to be published, but rather to guide his own mind to a sound conclusion on a difficult problem. It serves to illustrate Thompson's method and Thompson's work, and finds a fitting place in these *Transactions.*

A Critical Examination of the Objections urged against the Doctrine of the Aerial Convection of Small-Pox from Hospitals.

Some twelve years have now elapsed since the publication of Mr. W. H. Power's well-known Report on "The Influence of the Fulham Small-Pox Hospital on the neighbourhood surrounding it". The time has therefore perhaps arrived when a comprehensive review of the facts and arguments since brought forward against the aerial convection hypothesis, adopted by Mr. Power in that and subsequent Reports, as needful for the explanation of the observed distribution of small-pox around hospitals, may usefully be made. And the fact that the subject has recently been discussed at different medical societies—renewed attention having, no doubt, been directed to the matter by the increased prevalence of small-pox in the

country during the past two years—seems to afford a further ground for regarding the present as an opportune time for undertaking such an inquiry as that now proposed.

Now, the facts and arguments which we have to consider divide themselves naturally into two classes:—

A. Those cited for the purpose of showing that, apart from the occasional accidents met with in connection with all infectious diseases and due to gross hospital mal-administration, small-pox does not possess any appreciable tendency to spread from hospitals: a view which, of course, excludes the aerial convection hypothesis and the notion of special danger attaching to small-pox hospitals.

B. Those cited to show that the excessive spread of small-pox (as compared with other fevers) from hospitals, which is admitted, is due to direct or indirect infection of the commonly recognised sorts, consequent, doubtless, upon defective hospital and ambulance administration, and not to the atmospheric transmission of small-pox virus over long distances—a view which endorses the alleged danger of small-pox hospitals to surrounding populations, but differs from the aerial hypothesis as to the explanation of that danger, and therefore, of course, as to the measures necessary for averting it.

Considering first objections of the class A, they are found to be based mainly upon alleged negative evidence. Instances are adduced in which, during particular years, or even during a succession of years, cases of small-pox have been treated in particular hospitals within more or less close proximity to dwellings or public institutions, without, as it is affirmed, any extension of the disease beyond the limits of the hospitals in question.

Now, evidence of this kind must be received with very great caution, and that for several reasons. In the first place, the admission that their hospital has been spreading small-pox is an unpleasant one for a Sanitary Authority to have to make even to themselves, much less to the general public; and it is to be feared that a conscious or unconscious refuge in the *suppressio veri* must be held responsible for some share of the negative evidence in question. Where this source of error has not operated, however, much of the negative evidence, consisting as it does of mere general statements founded upon general impression, is of little worth. Further inquiry would, no doubt, show that in many of these so-called negative instances there had been some small-pox around the hospital, and that such small-pox, when mathematically examined as regards its amount

and graduated distribution, much more nearly coincided with the Fulham experience than had been for a moment suspected. A notable error of this kind was made in the Report of the Royal Commission on Small-Pox and Fever Hospitals in 1882. The Commissioners, influenced apparently by a general impression that the amount of small-pox which had occurred in certain public institutions adjacent to small-pox hospitals was insignificant in amount, committed themselves to a statement to that effect without testing it mathematically. When, however, the percentages were subsequently calculated by Mr. Power, it was seen that the incidence of small-pox on the institutions in question, according to the figures before the Commissioners, had been very much what would have been anticipated from the positions of those institutions in relation to the hospitals, even on the basis of the Fulham experience. The fact probably is that the absence of a serious and conspicuous outburst of small-pox around a small-pox hospital has been frequently regarded as evidence of the harmlessness of such hospitals, and therefore no adequate attempt has been made to trace the hospital influence by a mathematical study of the amount and distribution of known small-pox in its relation to the hospital.

But when all allowance has been made for errors of the kind above referred to, it doubtless remains true that a certain amount of the negative evidence is left intact—that is to say, in certain times and places, hospitals containing small-pox patients have not to any appreciable extent acted as disseminators of the disease. But what is the value of such evidence against the opposite facts positively observed elsewhere? Practically nothing. To regard it as valid is to assume that the alleged extension of small-pox from hospitals is due to a single unaided cause which is always uniform in its operation, and uninfluenced by any concurrent or coexisting factors.

Such, however, is obviously not the case. At the very least the phenomenon must be a resultant of three factors, viz., the small-pox virus, susceptibility of persons residing in the neighbourhood of the hospital, and the presence of circumstances inducing contact between the two. It will, however, be readily seen that the two latter factors are capable of further analysis into a variety of component factors, varying in amount at different times and places, though this may not at once be admitted as regards the first. By many persons, and especially by those who rely upon the negative evidence now under consideration, the

small-pox virus is no doubt habitually but hazily thought of as a simple factor in the sense of every case of the disease possessing the same quantity of a virus of fixed and uniform pathogenicity. But is this view supported by what we know of pathogenicity generally. The variation from time to time in the spreading power of the same infectious disease constitutes one of the most conspicuous features of maladies of that class; and although it is often hastily assumed that such variations are mainly due to variations in the susceptibility of recipients, and in the opportunities of infection, probably no one would be so bold, after due reflection, as to attribute them exclusively to those causes.

Such a view, even if regarded as adequate to account for the more or less regularly recurring outbreaks of certain indigenous diseases in particular localities, such as measles, would afford no explanation of such phenomena as the influenza pandemic, except, indeed, by those prepared to assert that England was ten years ago destitute of persons susceptible to that disease and of the means for its dissemination. It is true that the variations in question, in so far as they are not due to conditions of recipients and facilities for disease transmission, might be accounted for (and no doubt in great part correctly accounted for) by multiplication of virus apart from increase in pathogenicity —but the one by no means necessarily excludes the other. And while the progressive increases and decreases in the virulence of a given epidemic of disease, both as regards time and place, which is so frequently observed, is highly suggestive of variations of pathogenicity, variations in the pathogenicity of viruses have been proved by laboratory experiments to be easily inducible. It is doubtless true that the viruses of some diseases are more uniform in their operation than those of others, and that of small-pox may pretty safely be regarded as relatively stable. It is, however, equally safe to conclude that none of them are absolutely stable; and, as a matter of fact, the variations in pathogenicity, which have been induced in the bacteriological cabinet, have mostly been in viruses remarkable for the certainty of their operation, such as those of rabies and anthrax.

From what has been said, it will, I think, be clear that the dissemination of small-pox from a hospital must be due to a combination of causes consisting probably of some or all of the following, viz.: a small-pox virus; a particular amount and quality of such virus; the presence of persons

susceptible either naturally or due to neglected or defective vaccination; the conditions necessary for conveying the virus to and from hospital to susceptible persons, including defective hospital and ambulance administration, conditions of atmosphere, etc. Obviously, an effect dependent upon a combination of causes can only be expected to occur when all the needful contributory causes are in operation. It is therefore unreasonable to maintain that hospitals never spread small-pox because they do not always do so. It might as reasonably be argued that scarlet fever is not infectious because, when introduced into a household, it occasionally fails to attack more than one of a family of children unprotected by previous attack.

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